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FACTS AND THEORIES OF TELEGONY.

HERMON C. BUMPUS.

IT will be remembered that Professor Weismann, in a chapter of *The Germ-Plasm*, entitled "Doubtful Phenomena of Heredity," referred to what is generally known as *infection of the germ*, and gave to it the term "Telegony." Although he expressed some doubts as to the existence of the phenomenon, believing that the recorded instances of "infection" were based upon an insufficiency of data or misinterpretation of facts, he felt justified in considering its occurrence *possible*, since supposed cases of infection had been often discussed, and even Darwin had considered the subject worthy of special mention.

The belief that the male of the first coitus may influence the color, structure, and disposition of the young born to a female, of another sire, is almost universally held by stock-breeders, and so tenaciously that even the accidental contamination of a pure-bred female by a male of inferior blood renders her permanently undesirable for breeding purposes.

The question, however, had received no special attention from biologists previous to the Spencer-Weismann controversy

of 1893. At that time Spencer accepted telegony as an incontestable fact, called attention to experiments made by Mr. Nouel upon sheep, and described in the *Journal of the Royal Agricultural Society* for 1853; to others made upon pigs by Daniel Giles, Esq., and reported in the *Philosophical Transactions* for 1821; and to the famous experiment of Lord Morton, in which a nearly full-blooded Arabian mare, having been mated to a quagga, by which she had a hybrid foal, subsequently bore to a full-blooded Arabian stallion two foals, which were said to simulate the markings of the quagga. He concluded: "And now, in presence of these facts, what are we to say? Simply that they are fatal to Weismann's hypothesis. They show that there is none of the alleged independence of the reproductive cells; but that the two sets of cells are in close communion. They prove that while the reproductive cells multiply and arrange themselves during the evolution of the embryo, some of their germ-plasm passes into the mass of somatic cells constituting the parental body, and becomes a permanent component of it. Further, they necessitate the inference that this introduced germ-plasm, everywhere diffused, is some of it included in the reproductive cells subsequently formed. And if we thus get a demonstration that the somewhat different units of a foreign germ-plasm permeating the organism, permeate also the subsequently formed reproductive cells, and affect the structures of the individuals arising from them, the implication is that the like happens with those native units which have been made somewhat different by modified functions: there must be a tendency to inheritance of acquired characters."

Romanes expressed himself more cautiously. While admitting that telegony occurred, he questioned its frequent occurrence, and could not accept Spencer's explanation, nor agree with him that the phenomenon disproved Weismann's doctrine of the isolation of the germ-plasm.

In 1896 Dr. A. L. Bell published an article in the *Journal of Anatomy and Physiology*, in which he described several cases that purported to illustrate the influence of a previous sire, and described several experiments that he had made upon horses

and dogs for the express purpose of producing results which might be attributed to the influence of telegony. In the same year Karl Pearson examined the matter statistically, and showed that in man there was no evidence that the younger children of a family have characters more nearly resembling those of the father than do the eldest, for it is evident that if telegony really occurs the later offspring of the "infected" mother would resemble the father more than would the first-born.

Mr. Bulman has more recently called attention to the bearing that "hybrid-oölogy" has upon the question of telegony. The eggs deposited by a female bird of a certain species, after she has been mated to a male of another species, will often resemble, in their coloration, the eggs of the latter species. This fact, which appears to be well established, has been thought to prove that the sperm influences not the ovum alone, but the walls of the oviduct, which in turn imprint their acquired character upon the eggshell. It seems to the writer, however, that one is not driven to accept such a phenomenon as an instance of "maternal infection." The hen's egg is not the product of the undirected metabolic activity of the hen alone, but is the result of the joint activity of the combined oöcyte and sperm, — the oösperm, — and the coverings of the egg, the membranes and shell, in their elaboration, must be affected as well by the centrifugal influence of the oösperm as by the centripetal influence of the oviducal walls. The egg takes unto itself what it selects, not merely what is thrust upon it.

A paper strongly in favor of telegony, and partially based upon experiments, was written by Mr. Frank Finn, at the time of the Spencer-Weismann controversy, and published in *Natural Science.* The observations therein recorded, especially those upon varieties of the domestic fowl, are exceedingly interesting, and one would almost become convinced, had the experiments been made for the express purpose of securing definite data bearing upon the disputed question, and had adequate precautions been taken for the exclusion of errors. But it is this very lack of definite data, and the frequent admission

of evidence based upon anecdotes and traditions of obscure origin, that have made so many of the communications inconclusive and unsatisfactory. Of an entirely different nature are the efforts of Professor J. C. Ewart of the University of Edinburgh, who has lately published some of the results of his "Penycuik Experiments"; but although his work has received the well-merited attention of the British journals, American publications have been almost shamefully indifferent to its importance.

Professor Ewart began his experiments in 1895, when he secured three male Burchell's zebras. Two of these died, but the third became thoroughly acclimated. This zebra was mated to Mulatto, a black West Highland pony, and the hybrid colt Romulus, born in August, 1896, was even *more profusely striped* than the sire, which in its figure and general behavior it strongly favored. Now, following Lord Morton's experiment, Mulatto was sired by an Arabian horse, and, lo! and behold! like Lord Morton's colt, Mulatto's foal presented a number of stripes, although these were indistinct and visible only in certain lights. A third foal, born to Mulatto in May of the present year by a West Highland pony, Loch Corie, also showed indistinct markings.

It would thus appear at first sight that Mulatto's second and third foals lend support to the belief in telegony, but the Scotch professor did not stop here. Soon after the birth of Mulatto's third foal, two West Highland mares, similar to her, but neither of which had ever seen a zebra, had colts by Loch Corie, both of which were striped. It is thus seen that striped colts may be born to full-blooded parents without the "infection" of a zebra sire, and we are practically forced to give up our interest in the offspring of Lord Morton's mare.

Further experiments of Professor Ewart are as follows: A Shetland mare, mated to a black Shetland pony, had as her first foal a colt distinctly striped. Mated to the zebra, her second foal was the most zebra-like of all of Professor Ewart's hybrids; but when again mated, to a Welsh pony, her third foal, born after she had had an opportunity to become infected by the zebra or its hybrid foal, did not begin to have the conspicuous zebra-like markings of the first foal.

The crossing of Iceland, Irish, English thoroughbred and Arabian mares with the zebra, and the breeding of them subsequently to their own or closely related varieties, failed to afford the slightest evidence in support of the theory of the infection of the germ.

Although the "Penycuik Experiments" were evidently undertaken for the express purpose of proving the truth or falsity of the supposed phenomena of telegony, Professor Ewart struck upon certain by-products of no inconsiderable scientific value. It will be recalled that the existing striped horses are grouped under four species: the quagga (*E. quagga*) of South Africa, the most ass-like, and the one of Lord Morton fame; Burchell's zebra (*E. burchellii*), the species used by Professor Ewart, and occurring on the plains north of the Orange River; the true zebra, or mountain zebra (*E. zebra*), and the Somali zebra (*E. grevyi*) of Northeastern Africa. Professor Ewart is of the opinion that, as far as the coloration is concerned, the last is the most primitive of living zebras, and the colors and markings of the hybrid foals resemble those of this species rather than the color-pattern of their sire. In other words, the process of hybridization results in the resurrection of ancestral characters which have long remained latent, and his experiments show also that even the mere crossing of varieties, or the in-breeding of domestic animals may lead to the production of offspring possessing characters which are to be explained only on the principle of reversion.

Turning to Darwin's *The Variation of Animals and Plants under Domestication*, we read under the caption "Crossing as a Direct Cause of Reversion":

"It has long been notorious that hybrids and mongrels often revert to both or to one of their parent forms, after an interval of from two to seven or eight, or, according to some authorities, even a greater number of generations. But that the act of crossing in itself gives an impulse toward reversion, as shown by the reappearance of long-lost characters, has never, I believe, been hitherto proved. The proof lies in certain peculiarities which do not characterize the immediate parents, and therefore cannot have been derived from them, frequently

appearing in the offspring of two breeds when crossed, which peculiarities never appear, or appear with extreme rarity, in these same breeds, as long as they are precluded from crossing."

Lord Morton's mare was used by Darwin in this chapter, not because of its telegonous young, but because its first foal, the hybrid, had stripes "*more strongly defined and darker than those on the legs of the quagga.*" Professor Ewart, not alone by his experiments upon horses and zebras, but by experiments upon pigeons, fowl, and rabbits, has provided an abundance of evidence to prove the correctness of Darwin's views as set forth in this chapter, but he certainly shows that Darwin spoke with insufficient evidence when he said: "There can be no doubt that the quagga affected the character of the offspring subsequently begot by the black Arabian horse." His experiments, moreover, have yielded most welcome information of a definite nature respecting the benign and baneful effects of in-breeding, the unsettled questions bearing upon sterility and the strange phenomena which are associated with the word "prepotency." Both men of science and those interested in the practical occupation of breeding owe a debt of gratitude to Professor Ewart, an obligation that J. Arthur Thomson has acknowledged in a recent article in *Natural Science*, but a testimonial even more fitting would be the adoption of similar lines of research by our numerous and amply equipped agricultural schools and experiment stations. The vexed problems of heredity never will be solved until a great many individuals or institutions seriously undertake experimental breeding.

BROWN UNIVERSITY, Nov. 1, 1899.

A NOTE ON THE PSYCHOLOGY OF FISHES.

EDWARD THORNDIKE.

NUMEROUS facts witness in a vague way to the ability of fishes to profit by experience and fit their behavior to situations unprovided for by their innate nervous equipment. All the phenomena shown by fishes as a result of taming are, of course, of this sort. But such facts have not been exact enough to make clear the mental or nervous processes involved in such behavior, or simple enough to be available as demonstrations of such processes. It seemed desirable to obtain evidence which should demonstrate both the fact and the process of learning or intelligent activity in the case of fishes and demonstrate them so readily that any student could possess the evidence first-hand.

Through the kindness of the officials of the United States Fish Commission at Woods Holl, especially of the director, Dr. Bumpus, I was able to test the efficiency of some simple experiments directed toward this end. The common Fundulus was chosen as a convenient subject, and also because of the neurological interest attaching to the formation of intelligent habits by a vertebrate whose fore-brain lacks a cortex.

The fishes studied were kept in an aquarium (about 4 feet long by 2 feet wide, with a water depth of about 9 inches) represented by Fig. 1. The space at one end, as represented by the lines in the figure, was shaded from the sun by a cover, and all food was dropped in at this end. Along each side of the aquarium were fastened simple pairs of cleats, allowing the experimenter to put across it partitions of wood, glass, or wire screening. One of these in position is shown in the figure by the dotted line. These partitions were made each with an opening, as shown in Fig. 2. If now we cause the fish to leave his shady corner and swim up to the sunny end by putting a

slide (without any opening) in behind him at *D* and moving it gently from *D* to *A* and then place, say slide *I*, across the aquarium at 1, we shall have a chance to observe the animal's behavior to good purpose.

This fish dislikes the sunlight and tries to get back to *D*. He reacts to the situation in which he finds himself by swimming against the screen, bumping against it here and there along the bottom. He may stop and remain still for a while. He will occasionally rise up toward the top of the water, especially while swimming up and down the length of the screen. When he happens to rise up to the top at the right-hand end, he has a clear path in front of him and swims to *D* and feels more comfortable.

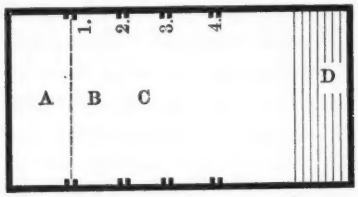


FIG. 1.

If, after he has enjoyed the shade fifteen minutes or more, you again confine him in *A*, and keep on doing so six or eight times a day for a day or so, you will find that he swims against the screen less and less, swims up and down along it fewer and fewer times, stays still less and less, until finally his only act is to go to the right-hand side, rise up, and swim out. In correspondence with this change in behavior you will find a very marked decrease in the time he takes to escape. The fish has clearly profited by his experience and modified his conduct to suit a situation for which his innate nervous equipment did not definitely provide. He has, in common language, *learned* to get out.

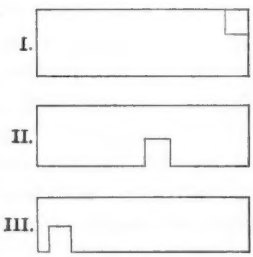


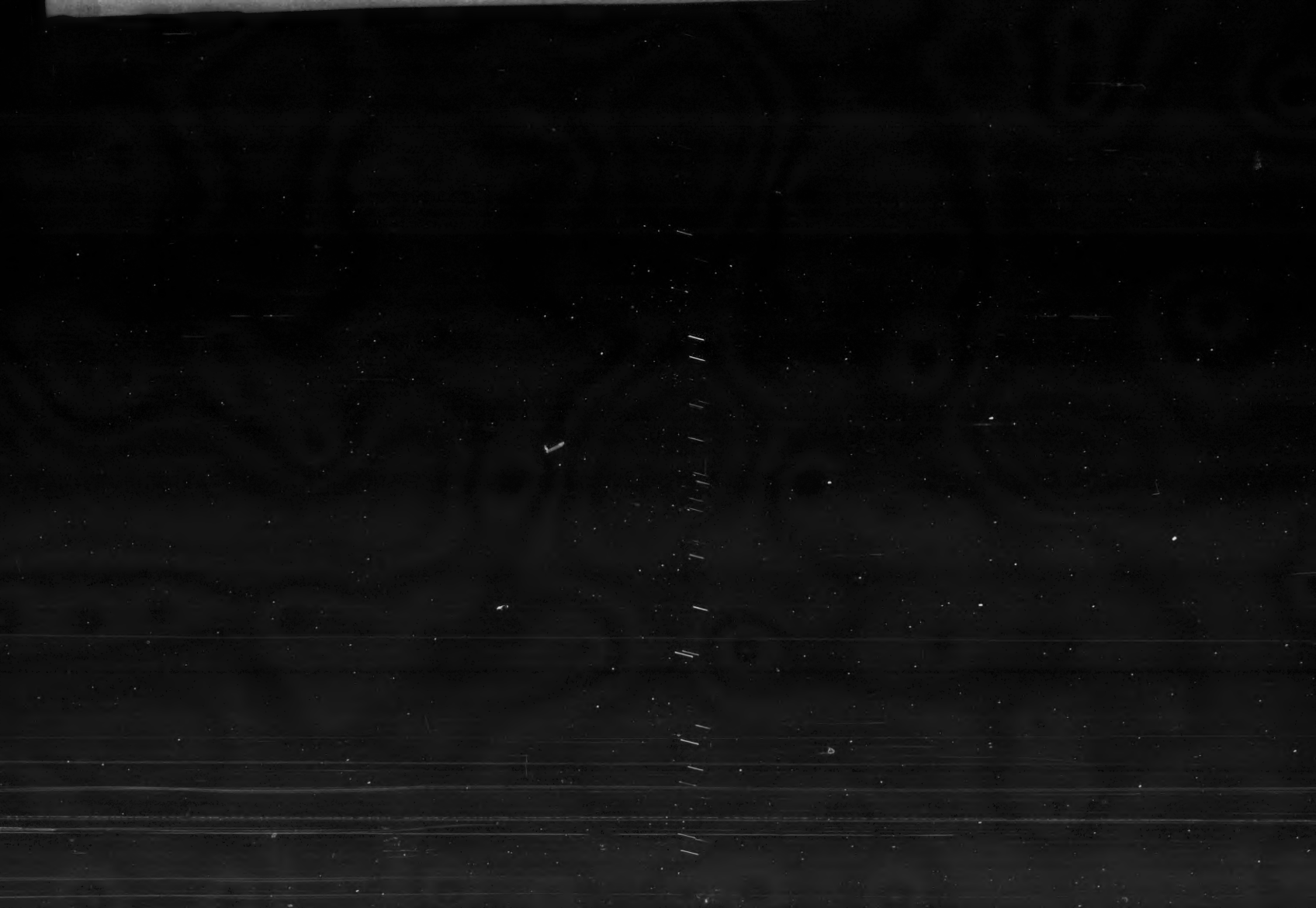
FIG. 2.

This particular experiment was repeated with a number of individuals. Another experiment was made, using three slides, *II*, *III*, and another, requiring the fish to find his way from *A* to *B*, *B* to *C*, and from *C* to *D*. The results of these and still others show exactly the same general mental process as does

the one described — a process which I have discussed at length elsewhere.[1]

Whatever interest there is in the demonstration in the case of the bony fishes of the same process which accounts for so much of the behavior of the higher vertebrates may be left to the neurologists. The value of the experiment, if any, to most students will perhaps be the extreme simplicity of the method, the ease of administering it, and its possibilities. By using long aquaria one can study the formation of very complex series of acts and see to what extent any fish can carry the formation of such series. By proper arrangements the delicacy of discrimination of the fish in any respect may be tested. The artificiality of the surroundings may of course be avoided when desirable.

[1] Animal Intelligence; An Experimental Study of the Associative Processes in Animals. Monograph Supplement No. 8 to the *Psychological Review*, June, 1898.



COLLOPS BIPUNCTATUS AS AN ENEMY OF THE COLORADO POTATO BEETLE.

C. E. MEAD.

On July 20, while searching the potato vines at Aztec, New Mexico, for insect pests, a beetle, *Collops bipunctatus*, was noticed eating a larva of the Colorado potato beetle. The beetle was carefully watched for about half an hour, and with the aid of a pocket lens I could plainly see that fully one-half of the larva had been destroyed and yet the beetle was gnawing contentedly away at the remaining portion.

This specimen was immediately caught for the purpose of confining it with other larvæ of the potato beetle and noting its actions.

After removing the beetle, the vine was carefully examined and found to have on its leaves two clusters of *D. 10-lineata* eggs; one cluster was wholly destroyed apparently by the *C. bipunctatus;* the other, which was yet in good condition, was preserved and placed with a few larvæ of the same species in a box containing the specimen of *C. bipunctatus*. The contents of the box were carefully watched, with the following results:

No sooner had the beetle carefully inspected its new quarters than it began searching the enclosed leaves. After a careful review of these it first proceeded to the ones containing the eggs. Here it began at once to eat the eggs, and continued until it had eaten or destroyed six; then it crawled away and hid itself beneath some leaves in the corner of the box, where it remained in seclusion for about ten minutes. It then left its hiding place and proceeded to where the larvæ of the *D. 10-lineata* were feeding upon some potato leaves. Here it stopped, surveyed its prey, and then attacked a small larva that was by itself at a short distance from the rest. It ate heartily, notwithstanding the protests of the larva, until about one-half of

the abdominal cavity had been consumed, when it again returned to its hiding place beneath the leaves in the corner of the box, where it remained for probably one-half hour, when it again resumed its work upon the remaining eggs. This time it did not leave the eggs until the whole cluster — eighteen in all — had been destroyed.

On the following day the same beetle was confined with three full-grown larvæ of the *D. 10-lineata* and carefully watched, as the day preceding. This time it made no attempt whatever to attack the larvæ, even though it was carefully watched for about two hours. It was then left in confinement with these three larvæ for two days, but never during this period of time did it attack any of the larvæ. Although a little discouraged, I collected several more specimens of the larvæ, which were exceedingly scarce in the potato patch of one-fourth acre, and confined them, as before, with the beetle. Fortunately this time larvæ of different sizes and ages were collected, and this explained the mystery of the preceding days. The beetle, as before, carefully inspected its new quarters and then reviewed its prey. After this it attacked some small larvæ that had recently been hatched and, with the exception of their heads, completely devoured the whole bodies.

On August 15 another beetle, *C. bipunctatus*, was confined with three larvæ of *Epilachna corrupta* and carefully watched for about an hour, but it did not attack any of them. In this state the box was set away and was not observed again until the following day, when it was found that one of the large larvæ, then beginning to pupate, was about one-half eaten. Apparently the beetle eats the larvæ of the *E. corrupta* only when forced to do so by hunger, and, when so compelled, it prefers the large larvæ to the small.

Several fields of potatoes in the vicinity of Aztec have been examined this year, and a great many *C. bipunctatus* beetles have been noticed, but there is no apparent damage from the ravages of the *D. 10-lineata;* and in several patches many destroyed eggs and the dried remaining portions of *D. 10-lineata* larvæ could be seen.

In conclusion, we have good reasons to believe that the main

crop of potatoes of this vicinity is annually saved from the *D. 10-lineata* by the predaceous habits of the *C. bipunctatus*, the presence of which, doubtless, is worth many hundreds of dollars to the potato growers of San Juan County, New Mexico, and maybe to those of elsewhere as well.

SAN JUAN SUB-STATION, AZTEC, NEW MEXICO,
August 19, 1899.

THE EGG-CARRYING HABIT OF ZAITHA.

FLORENCE WELLS SLATER.

It is a well-known fact that certain bugs of the family Belostomidæ carry their eggs on their back until they are hatched. This has been frequently observed in the case of *Zaitha fluminea*, which is common in the Atlantic States, and with *Serphus dilatatus* of the Western States.

It has been taken for granted by all who have described this habit that it is the female that carries the eggs. And Dimmock even states[1]: "These eggs are set nicely upon one end, and placed in transverse rows, by means of a long protrusile tube, or ovipositor, which the insect can extend far over her own back." Investigation proves, however, that, in the case of Zaitha at least, the credit of carrying the eggs belongs to the male, and that the ovipositor of the female is so short as to make it impossible for her to reach her back with it.

In the course of a study of the reproductive organs and genital armature of Zaitha, made in the entomological laboratory of Cornell University, I have had occasion to dissect many egg-bearing individuals, and in every case they have proven to be male.

The specimens used were collected in the vicinity of Ithaca, where the species is abundant in ponds; and as the egg-laying season lasts from June until the latter part of August, it was easy to obtain material for study. The insects were found most abundantly in shallow water, quite near the shore, clinging to the underside of aquatic plants, especially Marsilia.

The eggs of Zaitha are very large as compared with those of other insects. They number from seventy-five to eighty-five and are placed in regular diagonal rows on the upper side of the wings of the male. This makes a heavy load for the male

[1] *Annual Report of the Fish and Game Commissioners of Massachusetts* (1886), p. 71.

to carry and also deprives him of the use of his wings, confining him to one pond.

That the male chafes under the burden is unmistakable; in fact, my suspicions as to the sex of the egg-carrier were first aroused by watching one in an aquarium, which was trying to free itself from its load of eggs, an exhibition of a lack of maternal interest not to be expected in a female carrying her own eggs. Generally the Zaithas are very active, darting about with great rapidity; but an egg-bearer remains quietly clinging to a leaf with the end of the abdomen just out of the water. If attacked, he meekly receives the blows, seemingly preferring death, which in several cases was the result, to the indignity of carrying and caring for the eggs.

At other times paternal instinct seems to predominate, for with the third pair of legs, which are covered with long hairs, he brushes the eggs carefully to free them from foreign particles. Oftener, however, he vigorously kicks and pushes the eggs. In this way several of the males in my aquarium were successful in dislodging the eggs in a mass; then the hitherto meek, morbid Zaitha darted hither and thither with great rapidity, as if intent upon exhibiting to all the community his regained liberty.

The female is a trifle larger in size than the male and has two small hairy papillæ on the flap covering the genital armature; these are the only external characters which distinguish her from the male.

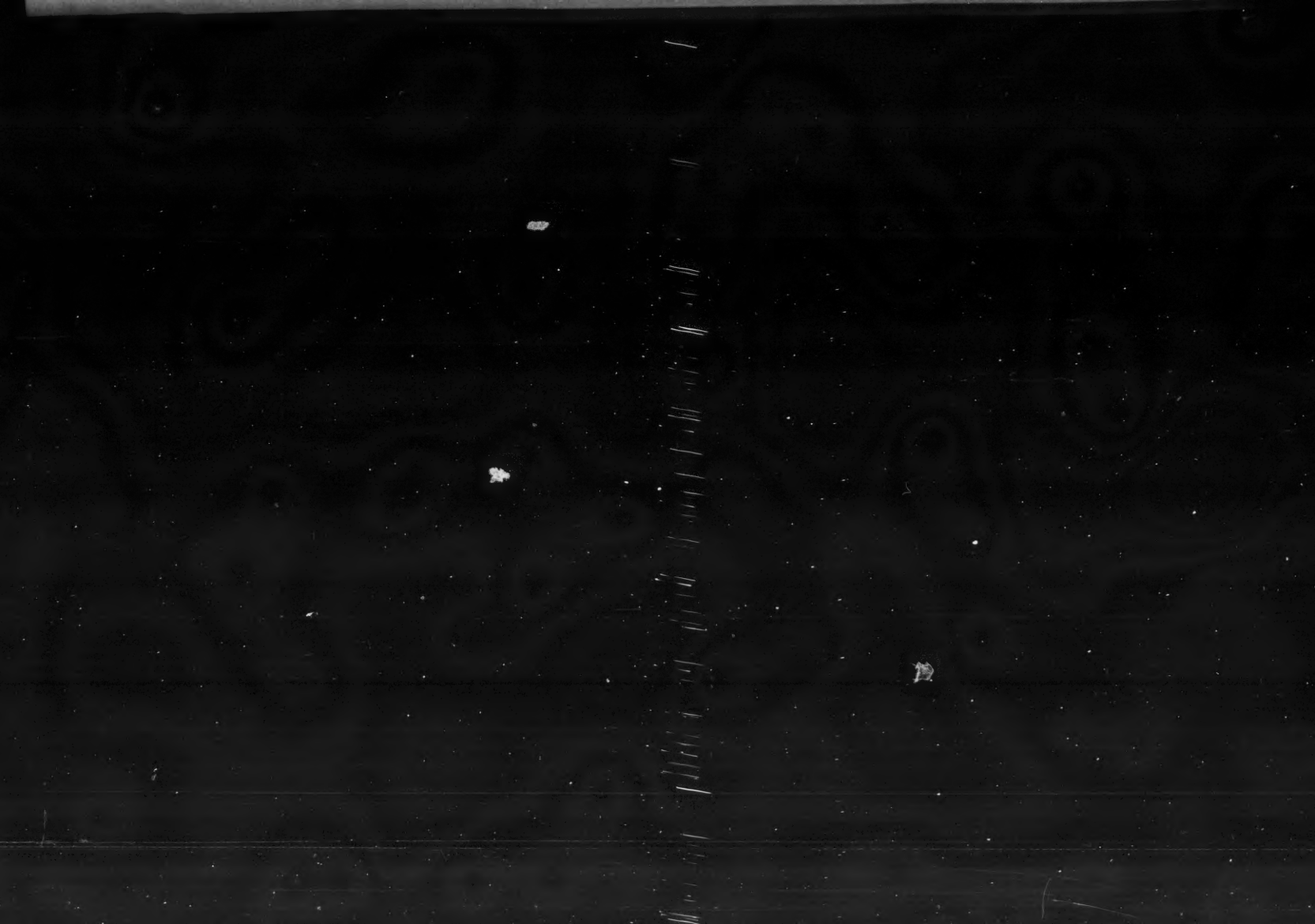
My observations indicate that the female is obliged to capture the male in order to deposit the eggs. Upon visiting the aquarium one afternoon a male was found to have a few eggs upon the caudal end of the wings. There was a marked difference in the color of these, those nearest the head being yellow, while those nearest the caudal end were dark gray. The small number of the eggs indicated that the female had been interrupted in her egg-laying, and the difference in color of the eggs, that the process must be a slow one.

For five hours I watched a silent, unremitting struggle between the male and the female. Her desire was evidently to capture him uninjured. She crept quietly to within a few

inches of him and there remained immovable for half an hour. Suddenly she sprang towards him; but he was on the lookout and fought so vigorously that she was obliged to retreat.

After this repulse she swam about carelessly for a time, as if searching for food was her only thought. But in ten or fifteen minutes she was back in her first position in front of him. Again there was the attack, and again the repulse. The same tactics were continued until midnight, when, despairing of her success, I left them.

At six o'clock the next morning the entire abdomen of the male and half of the thorax were covered with eggs. Those nearest the head were quite yellow, showing that the struggle had just ended.



RELATION OF THE CHIRPING OF THE TREE CRICKET (OECANTHUS NIVEUS) TO TEMPERATURE.

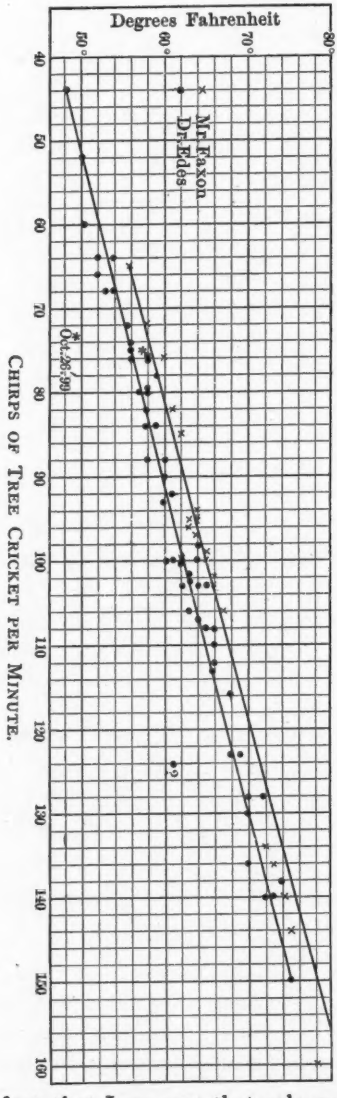
ROBERT T. EDES.

AMONG the shrill insect notes of the late summer and autumn nights, that of one of the crickets is easily to be distinguished from the others by a little attention, on account of its persistency and regularity. From nightfall until nearly daylight his monotonous chirp continues, affected only by weather and temperature, giving one the impression of a close attention to business entirely foreign to the character of careless freedom and irresponsible joyousness attributed to his kindred by the poets from Anacreon down.

Dr. Holmes alone seems to recognize in that "testy little dogmatist," the katydid, one of the same order of insects, a certain tenacity of purpose such as is appropriate to a resident in a less luxurious climate. It would be interesting to know whether this very positive insect is amenable to changes of temperature as quickly as his humbler cousin. In spite of the alleged use made of his relative the "black cricket," by Brian O'Lynn in the song, our friend is not the same personage at all; neither is he the "cricket on the hearth," although Keats recognizes in the latter a susceptibility to the same influences.

> On a long winter evening when the frost
> Has wrought a silence, from the stove there shrills
> The cricket's song, in warmth increasing ever.

As I am informed by Mr. Walter Faxon, the tree cricket (*Oecanthus niveus*) is the source of this persistent and rhythmical stridulation, being much more easily heard than seen, as he lives in leafy shrubs and stops his music when approached too closely. Hence the reader is referred to the Century Dictionary and works on entomology for a description.



A few years ago a note appeared in the *Boston Transcript* calling attention to the very exact dependence of the rapidity of the chirps upon the temperature of the surrounding atmosphere and giving a formula therefor.

In the *American Naturalist* for 1897, p. 970, may be found a brief article, by Professor A. E. Dolbear, also giving a formula, possibly the same. Professor Dolbear makes a claim for synchronism among many individuals which I have not observed, and attributes the phenomenon which he notes rather to the influence of temperature upon the whole orchestra than upon each performer. He says: "An individual cricket chirps with no great regularity when by himself, and the chirping is intermittent, especially in the daytime. At night one may hear all the crickets in a field chirping synchronously."

It seems to me that he may have been deceived by observing two different species, for the tree cricket does not say much in the daytime, but I have certainly located the noise so closely, within a few feet, that I am sure that only one insect was concerned in making it, and it lasted with perfect regularity within several minutes.

Whether the same individual kept it up all night I am unable to say. For several evenings together and for several hours in the same evening I often got a series of chirps from what I suppose to have been a single individual in the same vine.

As to the synchronism, it is true that several performers may be audible at the same time, but the intensity of sound increases rapidly as the individual is approached, so that when all are performing in the same *tempo* the nearest one gives the accent without all the others emitting their notes at exactly the same instant.

Professor Dolbear's formula is as follows:

Let T = temperature in degrees Fahrenheit; N = number of chirps per minute; then

$$T = 50 + \frac{N - 40}{4}.$$ This would give 100 chirps for 65°.

During some weeks this summer I have recorded a number of observations, amounting, with those taken in previous years, to fifty-six, and Mr. Faxon has kindly sent me a series taken by himself.

All three sets and formulæ agree as to the rate of increase, *i.e.*, four beats to a degree, but mine differ from the other two in making the absolute value either two or three degrees lower, as will be seen in the accompanying diagram, in which I have indicated the separate observations of Mr. Faxon and myself, as well as in the tables.

It will be seen that in one-fifth the rule is exact for either 62° or 63° to the hundred, and in four-fifths the error is one degree or less.

One Hundred Chirps Corresponding to	62°	63°
Exact	11	11
Error 1° or less	29	29
Error 2° or less	10	12
Error 3° or less	5	3
More than 3°	1	1

I have little doubt that the errors would be even less if my methods of observation had been more accurate, *i.e.*, chiefly if the thermometer had been in the immediate neighborhood of the performer instead of being on the other side of the house from the vine, whence many of the notes were taken.

It would be very interesting to see whether our "snowy tree cricket" could be induced to give a chamber concert like his black cousin on the hearth, and to try whether an artificial change of temperature would change the rapidity of the music.

To physicians and nurses some interesting comparisons with the rhythm of the pulse as affected by temperature in febrile diseases will be suggested.

REGENERATION IN THE HYDROMEDUSA, GONIONEMUS VERTENS.

T. H. MORGAN.

HAECKEL,[1] in 1870, stated that he found the power of regeneration remarkably developed in several species of medusæ belonging to the family Thaumantidæ. He discovered that if a medusa be cut up into more than a hundred pieces, each piece, provided it contains a part of the margin of the bell, will develop a complete medusa ("*eine vollständige kleine Medusa*"). The little medusa developed in a few (two to four) days. Even a single tentacle, if it contained at its base a small part of the margin of the bell, would make a new medusa. No details are given, and it is not possible to gather from the account whether new organs developed, as one would expect, if the little medusa was complete (*vollständig*), or whether only the medusa-form was assumed by the pieces.

Haeckel also added that if the segmented egg, or even the ciliated larva, was cut up into many pieces, each piece would make a new small larva.

Hargitt[2] described in 1897 the results of a number of experiments that he had made on the regeneration of the medusa Gonionemus. He found that excised portions of the margin of the bell regenerated promptly, but it is not clear in this case whether he meant by regeneration that the cut edges closed together, or whether the parts cut off were replaced. When the medusa was cut into two equal pieces, each became an "independent and perfect medusa." The restoration was somewhat peculiar. "It would seem to be a *recovery* of form and function rather than regeneration in the usual sense of that term." "The new medusæ were in most respects quite simi-

[1] Monographie der Moneren., *Biologische Studien*, Heft 1 (1870), p. 23.

[2] Hargitt, C. W. Recent Experiments on Regeneration, *Zoölogical Bulletin*, 1897, vol. i.

lar in form and action to the original, though of course only about half the size. The time at my disposal was insufficient to observe whether there was subsequent growth of the specimens. In the recovery of the specimens I was not able, moreover, to observe any disposition to regenerate the additional radial canals necessary to complete the symmetry of the original. This, however, does not seem to be an important matter, since there does not seem to be a special necessity for a definite number."

Hargitt also cut the medusa in two in a horizontal plane — one piece being bell-shaped and the other a ring. The former showed evidence in one case of forming new tentacles; the latter produced a new medusa. Referring to the latter, Hargitt states that "the process appeared as more a restoration of form" than the formation of a typical medusa. Neither mouth nor gastric cavity developed. The figure given to illustrate this shows a small medusa with only fourteen tentacles around the margin, while the original piece contained thirty-eight tentacles. The absence of twenty-four tentacles is not accounted for, and is a point of some theoretical interest, since one of the important problems in connection with the development of a small medusa out of the ring is whether the old organs are retained intact or changed over into new ones proportionate in number and size to the smaller dimensions of the new individual. Hargitt also showed that if the manubrium is excised close to the stomach it is regenerated (*i.e.*, a new one develops).

These interesting experiments of Hargitt, although lacking in some details, show clearly that pieces of the medusa as small as one-fourth the whole have a remarkable recuperative power, leading to the production of the bell-like form. The account leaves the question open, whether these bell-like individuals will produce the missing organs if kept for a longer time. My object in studying the process of regeneration in this jellyfish was to find out more definitely by what means it regained its medusa form; whether by the development of new tissues and new organs, or whether by a rearrangement of the old part. Further, to find out if, after some time, the organs of a typical

medu a reappeared, and to examine the behavior of pieces take om different parts of the body. It was not clear to me exactly what took place, or how the change was brought about; and the results show that the problem is not a very simple one.

Gonionemus has generally four radial canals diverging from a well-defined central stomach. From the latter hangs down a

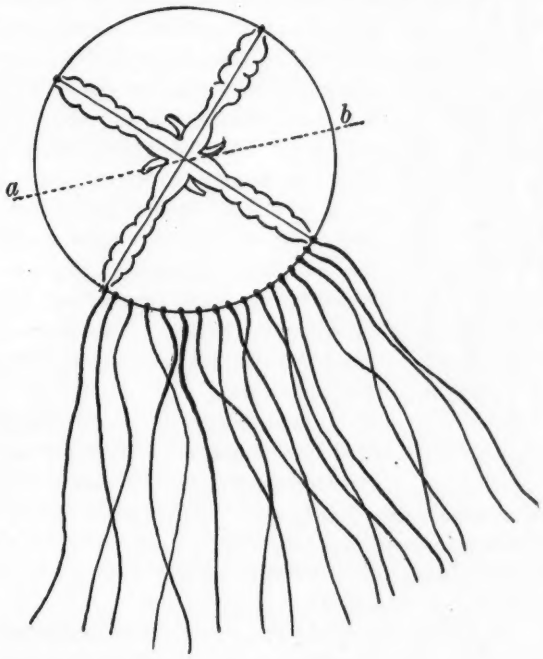


FIG. 1.

short manubrium. The individuals vary in size. I have generally used those of medium and large size (10 mm. to 20 mm. in diameter). The number of tentacles also increases as the medusa grows larger. In a very small individual there were twenty-four tentacles; in one a little larger, thirty-two tentacles; in a larger one, forty tentacles; and in quite a large specimen there were about sixty-four tentacles.

When a medusa is cut in two in a vertical inter-radial plane,

as indicated by the line *a–b* in Fig. 1, the cut surfaces bend slowly inwards and towards each other, and in the course of twelve to twenty-four hours they have met and fused along their entire length. As a result, the semicircle of tentacles now forms a complete smaller circle. The cut edges of the velum also meet, leaving an opening in the center of the velum, as in the typical medusa. The general form of the new individual is like that of the typical form, except on one side the bell is at first less rounded. It can swim about, eat, and I have been able to keep them alive for several weeks. A glance will show, however, that a typical medusa like the one from which the piece was taken has not been formed, for only two radial canals are present that extend out from the stomach (Fig. 2). The latter does not lie at the top of the subumbrella space, but somewhat to one side (Fig. 3). From the stomach arises a new manubrium. If the old manubrium was cut in half when the medusa was divided, each half makes a complete manubrium ; but if, as is often the case, the cut passed to one side of the original manubrium, then one piece retained the old manubrium, and the other piece developed an entirely new one.

FIG. 2.

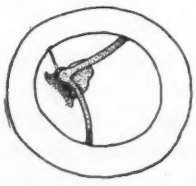


FIG. 3.

Along the line where the cut edges fused together a scar is present that resembles somewhat a third radial canal, but the third canal did not develop, although in some cases a short diverticulum may extend from the stomach for a short distance along this line. If the tentacles be counted after the operation, and then again when the piece has healed, the number will be found to be the same, and this holds true for several weeks. It is possible of course that a few new tentacles may develop, since they develop also in the normal individual as it

grows larger. Occasionally one or two new tentacles are found in the region where the parts have united, but as a rule I have not noticed any increase in the number.

If a medusa be cut into four parts, each containing one of the radial canals, then each piece gives rise to a small medusa-like individual. The cut edges come together and fuse ; the tentacles form a circle, and a velum is also formed with an opening in the middle (Figs. 4 and 5). The new manubrium arises from one side of the bell (Fig. 4), and not from the top of the subumbrella space. Its point of origin is determined by the position in the new individual of the portion of the original stomach. During the process of fusion of the cut edges the proximal end of the radial canal is carried in some cases far over to one side of the new bell. In such a case the manubrium appears to arise just inside of the line of tentacles. In other cases the proximal end of the radial canal is not carried so far, and in such cases the manubrium hangs down from higher up in the subumbrella space. While the form of the one-fourth medusa has in general the typical bell-shape, yet such individuals have only one radial canal and an eccentric manubrium. It may be thought that the process up to this time is only one of healing, and that later the missing parts would regenerate. In the hope of seeing if this were true, I kept alive some of these medusæ for several weeks, and although they seemed to be in excellent condition, yet they did not show the least sign of regenerating the organs that make a complete medusa.

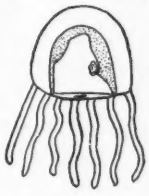


FIG. 4.

FIG. 5.

These experiments suffice to show that while the healing power of the one-half and one-fourth fragments is very great, yet the regenerative power is not well developed, for neither do the old parts change over into new ones having the typical arrangement (except in so far as the medusa-form is produced), nor do the missing parts regenerate (except the regeneration of a new manubrium) where the edges have healed together.

If only one quadrant is cut out, the larger part (three-fourths piece) forms a medusa having three radial canals and three-fourths the number of tentacles.

Other experiments were made to see if smaller pieces than one-fourth would develop into the form of medusæ. These smaller pieces were cut off in different ways and from different parts of the medusa. If the jellyfish is taken from the water and laid on its side on a glass plate, a portion of one side may be easily cut off in the way indicated by the line *a–b* in Fig. 6. A piece cut off in this way will contain only a part of one radial canal, but somewhat more than one-fourth of the margin with its tentacles (approximately one-third in this case). If the plane of division is less oblique, as indicated by the line *c–d* in Fig. 6, then the entire piece in all its parts is smaller than one-fourth the entire medusa. In both experiments a small bell-shaped individual develops from the piece. The new manubrium regenerates from the cut end of the radial canal, and lies to one side of the new medusa. This shows that a new manubrium may develop from the radial canal some distance from the original stomach.

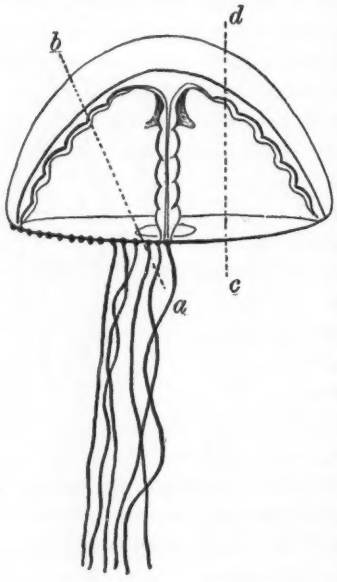


FIG. 6.

Small pieces were also removed in another way. The proximal part of the bell was cut off from the distal part, as shown by the line *a–b* in Fig. 7. Then the distal ring was cut up into smaller pieces, as indicated by the vertical lines in the same figure. In one case the ring was cut into four equal parts, each with a part of a radial canal. The pieces closed in, but somewhat imperfectly, and although they were kept for twenty

days they did not assume the typical medusa-form. In another case the distal ring was cut into eleven pieces. Four of the pieces contained the distal end of a radial canal; the rest did not contain any part of the radial canals. About half of the pieces showed later little resemblance to the medusa-form. They became swollen and irregular, and although kept for twenty days did not develop further. Other pieces became somewhat bell-shaped, but in none of them was the medusa-form well developed. These pieces seemed, therefore, to be near the lower limit of size necessary for the formation of even the medusa-form, although it is possible that even smaller pieces of a different shape might produce the characteristic form.

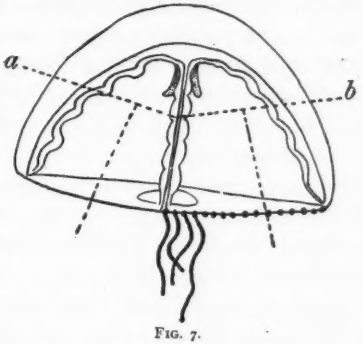


FIG. 7.

The following experiment was made to see if, in the absence of a definite structure such as the radial canal, a piece might regenerate a new radial system having the typical form. A jellyfish was placed oral side down on a glass plate, and with a knife, or with scissors, an inter-radial piece triangular in outline was cut out (Fig. 8, *A*). A piece of this sort does not contain any part of the central stomach or of the radial canals. It contains a part of the endoderm in the form of a plate extending throughout the middle of the piece, and a ring canal around the margin. In all, forty-eight pieces of this kind were cut out. Most[1]

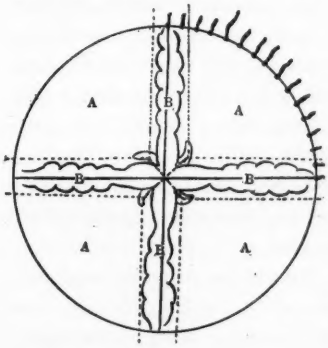


FIG. 8.

[1] Some of them died, especially in one experiment, due to too many being kept in the same dish.

of the pieces closed in and the old tentacles formed a ring encircling the margin. The piece assumed, in a general way, the form of the medusa (Fig. 9), and from the middle of the lower side a proboscis-like outgrowth developed (stippled in the figure). In the center of the bell two cavities are present. In order to interpret these structures it was necessary to make serial sections. The sections show that the larger cavity (stippled in the figure) represents the subumbrella space, and is therefore lined by ectoderm. This ectoderm continues down into the proboscis-like structure of the lower side.

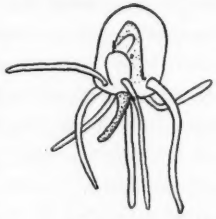


FIG. 9.

The outer surface of this structure is covered by the outer ectoderm. It represents, therefore, not a new manubrium, but a tubular outgrowth of the velum, the latter having completely closed over the lower surface. The outgrowth is fringed along one side and might easily be taken for a new proboscis, but sections show, in the clearest way, that it does not represent that organ. The other cavity seen in the figure lies on the side where the piece closed in. It represents an enlargement of the ring canal and is continuous with the ring canal around the base of the tentacles. The results show that the small piece, while assuming the form of a bell, is completely lacking in the essential organs of the medusa.

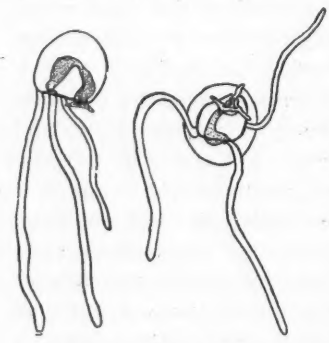


FIG. 10. FIG. 11.

In this same experiment the cross-shaped piece that remained after the four triangular pieces had been removed was itself cut into four pieces through the stomach (Fig. 8, *B*). These small pieces sometimes developed into medusa-like forms, each with a manubrium, but did not reproduce the other missing parts (Figs. 10 and 11).

Quite a number of experiments were made at different times

to see if the proximal end of the bell, with its contained organs, *viz.*, the stomach, manubrium, and the proximal ends of the radial canals, could develop a new circle of tentacles, sense-organs, etc. Hargitt has described one case in which there was some evidence of the development of new tentacles, but the piece died without further development.

In this experiment I cut off the proximal bell portion, sometimes by cutting around with a pair of scissors, sometimes by laying the jellyfish on its side and cutting off the margin with a knife.

Some of the proximal pieces were small, some large, some had been cut off by a nearly circular line, others by two or three oblique lines. In most cases the bell portion contracted, after a day or two, around the base of the manubrium, but no further development took place. In other cases the cut edges met and fused to form a sphere entirely closed. These kinds of pieces disintegrated after several days. Forty pieces in all behaved in one or the other way. It will be noticed that in nearly all these cases the part removed had been cut off less than halfway down the side of the bell, or near that level. It occurred to me that if the margin of the bell were cut off not so high up as before, but farther down, better results might be obtained, both because larger proximal pieces would result, and also, the cut edge being nearer to the old tentacles, the new ones were more likely to develop. In thirteen individuals the margin was removed as just described. Two of these showed, five days after the operation, small opaque projections around the margin of the cut edge. In one of these (Fig. 12) there were twenty of these small knob-like bodies. Although these grew somewhat more distinct and slightly larger during the next day or two, they failed to develop further. These two cases are similar to the one described by Hargitt. He attributed the failure of the knob-like projections to develop into tentacles to the unprecedented hot weather that prevailed at the time. But although I kept one of the two pieces for

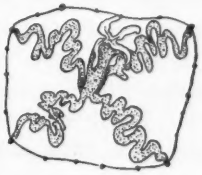


FIG. 12.

a week or more after the knobs appeared, they failed to develop. Considering the large number of experiments that I have made, I am inclined to think that Hargitt overestimated the capabilities of pieces of this sort. The result, it seems to me, follows only when the cut has been made near the margin of the medusa. The peripheral rings that had been cut off in the preceding experiments, fifty-three in number, were kept alive to see if, as stated by Hargitt, they too would give rise to medusæ. All those pieces from which a large part of the bell had been removed failed entirely to close in, and died after a few days. It seems that under very favorable circumstances a piece from which only a small proximal part has been removed may again develop into a complete medusa, and in fact, in one or two cases, this seemed very nearly accomplished. In one case a new stomach formed, and a very small manubrium; in another case the proximal ends of two of the canals united, and a small manubrium developed, but lay somewhat eccentric in position. The difficulty seems to be in the closing in of the ring rather than in the regeneration of a new stomach and manubrium. This is shown by the following experiment:

In several cases I cut out from the oral side the entire stomach and its attached manubrium, as well as the immediate proximal ends of the radial canals. Care was taken to remove completely all the endoderm in this region, but the cut did not pass through the jelly of the bell. I hoped to see if, under these circumstances, a new stomach and manubrium would develop, or if from each of the proximal ends of the radial canals a single manubrium would sprout forth. The latter possibility would seem to exist in the light of the experiments on the one-half and one-fourth pieces. If, on the other hand, a new stomach and a single manubrium developed, this would seem to indicate some sort of interrelation of the parts with one other (the canals are, of course, connected by a plate of endoderm). The endoderm grew forward over the region previously occupied by the stomach, and out of it was formed a stomach from which a new manubrium grew out.

It has been shown that in the one-half and one-fourth

medusæ the new manubrium develops always from the cut end of the radial canal. It often lay far to one side of the center of the new bell. I tried in another experiment, cutting in two the radial canal in the one-fourth piece at the middle of the canal, *i.e.*, at a point that would correspond approximately to the middle of the new bell. Under these conditions it was possible that a new manubrium might develop at this point, rather than at the other proximal end of the tube. This result did not follow, however, since, at the cut, the ends came together and fused. The experiment might succeed if the cut ends could be kept apart, or if a short piece were cut out of the canal at some point.

Finally I cut off the rim with its tentacles from three of the four quadrants, leaving only one quadrant entire. The experiment was made to see if, when a part of the rim was left, it might give rise at its free ends to the missing part of the ring, or possibly, under these conditions, the injured part of the rim might more readily produce new tentacles. The medusa closed in so that the opening into the subumbrella cavity became quite small. The opening was surrounded for the greater part of its extent by the tentacles of the uninjured quadrant. Over a small region no tentacles were present at first, but after five days a few new ones appeared. They were not more numerous near the ends of the uninjured part of the ring than elsewhere. The result is similar to that in which the entire margin is cut off (Fig. 12), although in this case the new tentacles were better developed.

The results of these experiments show, for Gonionemus at least, that Haeckel's statement, that even the smallest pieces may make new medusæ, is not correct; for although pieces somewhat smaller than one-eighth of the medusa may make new individuals having the medusa-form, yet these small individuals, as well as larger ones, lack the most essential features of the medusa. The remodeling extends only to the form of the entire piece and does not include the internal organs.

It is puzzling to determine whether the medusa-form assumed by the pieces is simply the form that necessarily results after the fusion of the cut edges, or whether the process includes

something more than this. When I recall how similar in form the small medusæ are, coming as they may from pieces of very different shapes, I am inclined to believe that there is something more in the process than only the fusion of the cut edges, and that the piece does in reality mould itself into the medusa-form, as Hargitt pointed out.

The further question suggests itself for consideration: Is the process by which the edges bend in and ultimately fuse simply a mechanical result depending upon the tensions set in play when part is cut off? I think not, at least not entirely. The bending takes place very slowly, and not quickly, as would be the case were it simply a roughly mechanical process. The form of the piece continues to change even after the edges have met and fused, pointing, I think, to the conclusion that the entire process is one of rounding up of the piece in the direction of least resistance.

The meeting of the edges may sometimes be due simply to an accidental meeting of the bent-in portions, but generally the process is a more orderly one, and of such a sort that it seems to be correlated with the process of remoulding. The fact that the cut edges always succeed in finding each other, even in very unsymmetrical pieces, shows that something more than a gross physical process is at work.

If we attempt to analyze the process so far as is possible at present, we can, I think, make out the following factors. The bending in, taking place in the piece as a whole, seems to be the result of active changes in the living tissues. This leads to the piece assuming more and more the typical form. The meeting of the edges may be due sometimes to accidental contact resulting from the bending in of the piece, but more often the closing of the cut surface is due to a sequence of well-defined events. At some point where two cut edges make an angle with each other they begin to draw together at the angle. The process proceeds from this point until, step by step, the complete fusion is brought about. It is as though, first at the angle, the parts that are continuous around the angle draw together, and the edges coming together fuse. Then new parts that are brought up to the new angle repeat

the process until the entire cut edges are drawn together. There is no evidence that parts widely separated attract each other across the intervening region, as in cases of cytoplasm described by Roux. The cytoplasm is confined to those parts in contact, or at any rate so near together that they may be connected by protoplasmic processes.

I have said enough to show that the process by which the piece closes in is a complex one, in which several factors take part. It is towards the discovery of these simpler processes that take place during regeneration that we can at present, I think, most profitably direct our attention. For if, as appears to be the case, many components enter into the process that we call regeneration, we can only hope to understand the phenomena as a whole when we have resolved it into the immediate simpler factors of which it is made up. Then no doubt we shall find out that we can in turn resolve these factors into simpler ones, and our analysis will be carried a step farther. As long as we interest ourselves with the facts and factors of regeneration the work is not likely to come to a standstill, but when we leave the analytical method and attempt to construct injudicious theories that make the pretense of explaining a complicated process without attempting to resolve the process itself into its factors, then progress stops. Such, I believe, to be the case in the attempt to explain the process of regeneration by a theory of preformed imaginary germs. A theory of this kind is only a pretense; imagination takes the place of verifiable hypothesis, and the process that we set out to study is explained by saying that there are "germs" present that have been set aside to bring about the result!

SALVIA COCCINEA, AN ORNITHOPHILOUS PLANT.

RICHARD C. McGREGOR.

SOME time ago my attention was called to an Anna's Humming Bird (*Calypte anna*) visiting the flowers of a small garden shrub. Feathers at the base of the upper mandible were thickly covered with a yellow substance, undoubtedly pollen; something which I had not previously noticed in the hummers. The question was at once suggested, Does this plant depend upon birds for cross fertilization?

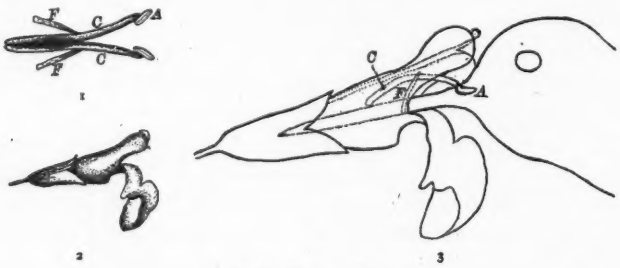
An examination of blossoms showed them to have the following described structure. The green striated calyx and scarlet labiate corolla are not striking. The pistil is bifurcate, the points protruding from the upper corolla lobe. The upper point is greatly recurved, the other slightly curved forward and downward. The stamens, two in number, are of an odd form, well known, however, to those familiar with this genus.

Their filaments are adherent to the corolla to within a short distance of its mouth, where they become free and run obliquely upward and forward, terminating on either side, close beneath the base of the upper lip. The connective is prolonged in each stamen into a slender longitudinally placed rod. Each connective is attached at its middle by a hinge joint to the end of its filament, thus forming an oblique lever with equal arms. The connectives are united for half their length. The anther-bearing ends are free, forming a Y-shaped affair with the arms close together (Fig. 3).

Experiments with a hummer skin and a salvia blossom demonstrate the method of fertilization. The posterior end of the lever is raised by the bird's bill, lowering the divided, anther-bearing end, one branch of which brushes each side of the bird's head, leaving its pollen among the feathers (Fig. 2). The sharp-pointed lower fork of the pistil in turn removes some of the pollen as the bird withdraws its bill. This may

come from its own anthers, or the anthers of another blossom. In dozens of flowers examined the pistil held pollen grains on its recurved tip.

It seems quite improbable that any of the bees or butterflies could force an entrance to this flower, while its scarlet color indicates that it does not bid for help from the night flying Lepidoptera. Several blossoms were found in which there was a small puncture at the base of corolla tube. These were at first attributed to bees, but as I later found a lepidopterous



Salvia Coccinea Linn.

1. Blossoms, ⅔ natural size. 2. Enlarged optical section, showing connectives raised by birds' bill and pollen being deposited on the feathers. 3. Free ends of filaments, connectives and anthers; enlarged. *A*, anthers; *C*, connectives; *F*, free portion of filaments.

larva in the act of making one of these holes, I now doubt if the bees use the trick with this salvia.

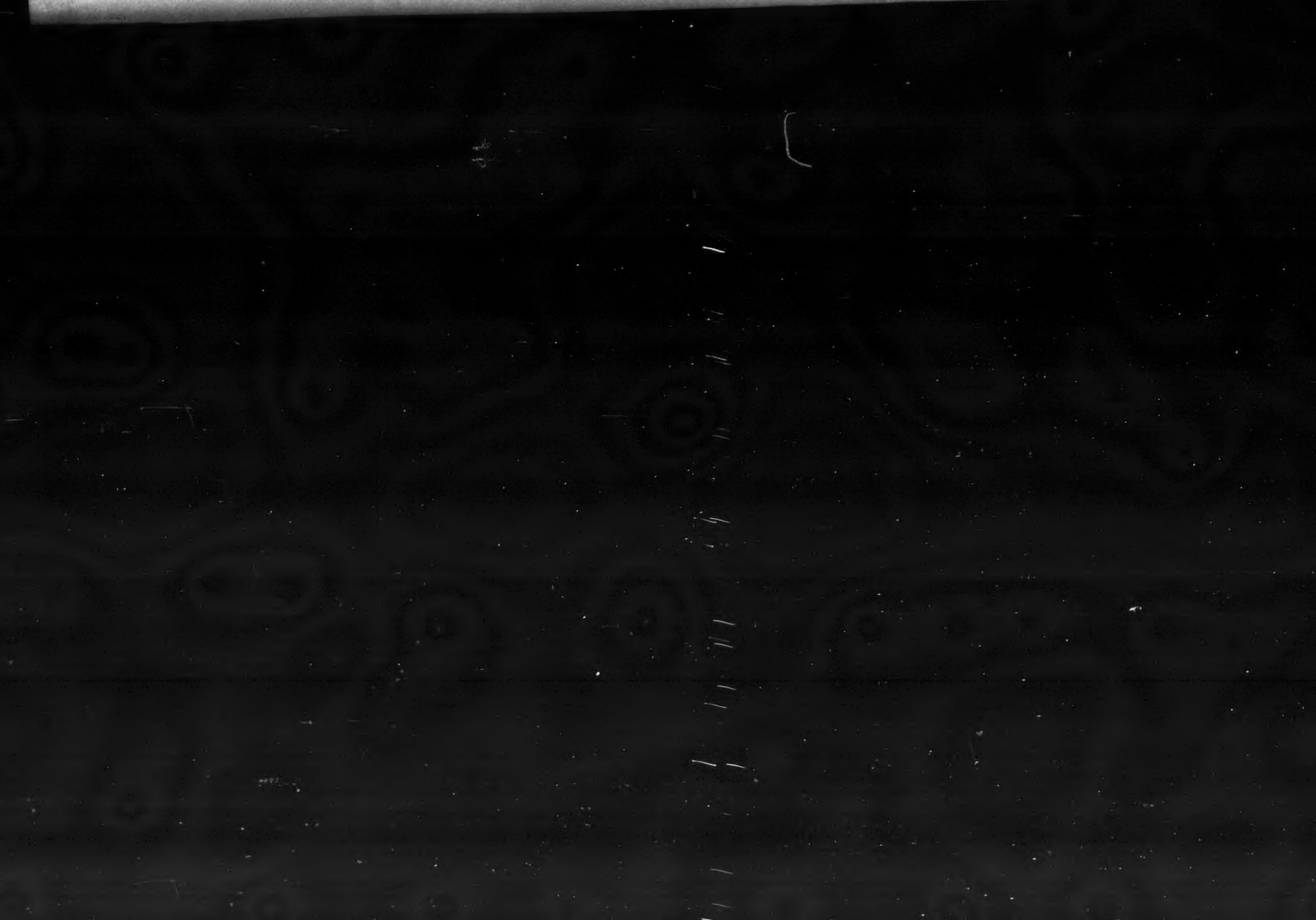
In the humming birds we have an agent fitted at once for tripping the stamen lever and carrying a load of pollen. Anna's Hummer has a bill .68 inch long, while a smaller species found here, *Selasphorus rufus*, has an exposed culmen .64 inch in length. These easily reach the bottom of the salvia corolla tube, which is .52 inch from base to mouth.

Dr. William Trelease has described a similar fertilization of *Salvia splendens* Sellow by the Ruby-throated Hummer (*Trochilus colubris*), *American Naturalist*, April, 1881. Dr. Trelease thus describes the life of an individual blossom:

"The life of a given flower may be divided into three periods: in the first, the anthers only being mature, it is staminate in function; in the second, some pollen remaining in the anthers,

while the stigmas become receptive, it is functionally hermaphrodite or perfect; and in the third, the pollen having been entirely removed, while the stigma, if unfertilized, retains its freshness, it is pistillate only so far as function is concerned" (*loc. cit.*, p. 266).

Professor W. C. Dudley kindly identified the present species for me as *Salvia coccinea* Linn.



SYNOPSES OF NORTH-AMERICAN INVERTEBRATES.

VI. The Astacidæ of North America.

W. P. HAY.

The following synopsis of the genera Astacus and Cambarus will be found to include all the valid species reported from the whole continent of North America.

The crayfishes, our largest and most conspicuous fresh-water crustaceans, are well known to every student of animal morphology. They occur in abundance in most lakes and streams, and, with the exception of the New England States and the Great Plains region, most localities will be found to support several species. They are especially abundant, individually and as species, in the southern and central portions of the United States.

In form, size, armature, color, and habits there is the greatest variation among the seventy-nine species and subspecies now recognized in the genus Cambarus and the five known species of Astacus. Moreover, almost every species is liable to show the most perplexing variations beyond those depending upon age and sex. On this account the identification of many species becomes exceedingly difficult, and in some cases is possible only when a set of type specimens is at hand. It is thought, however, that a careful use of the synopses given will enable even a beginner to identify with accuracy all but the most puzzling species. In the first list the natural groups are given with the characters distinguishing them, and the geographical distribution of each species is roughly indicated. The second list is a purely artificial key, based upon trenchant characters, by which any specimen, male or female, may be identified.

The most important papers on North American Astacidæ are :

1. Harlan, R. *Trans. Amer. Philos. Soc. Philadelphia.* Vol. iii, p. 464. 1830.
2. Tellkampf, T. *J. Mueller's Archiv*, p. 383. 1844.

3. ERICHSON, W. F. *Wiegmann's Archiv*, xii. Jahrgang 1, p. 86, und Nachtrieb, p. 375. 1846.
4. DANA, J. D. *Proc. Acad. Nat. Sci. Philadelphia.* Vol. vi, p. 15. 1852.
5. GIRARD, CH. *Proc. Acad. Nat. Sci. Philadelphia.* Vol. vi, p. 87. 1854.
6. LE CONTE, JOHN. *Proc. Acad. Nat. Sci. Philadelphia.* Vol. vii, p. 400. 1855.
7. STIMPSON, WM. *Journ. Bost. Soc. Nat. Hist.* Vol. vi, p. 93. Pl. VI. 1857.
8. SAUSSURE, H. DE. *Rev. et Mag. de Zoölogie.* Vol. ix, pp. 99–102, 503. 1857.
9. HAGEN, H. A. *Ill. Cat. Mus. Comp. Zoöl.*, No. 3, pp. 1–110, Pls. I–XI. 1872.
10. COPE, E. D. *Am. Nat.* Vol. vi, pp. 406–422. 1872.
11. HAGEN, H. A. *Am. Nat.* Vol. vi, p. 494. 1872.
12. BUNDY, W. F., and FORBES, S. A. *Bull. Ill. Mus. Nat. Hist.*, No. 1, pp. 3–25. 1876.
13. BUNDY, W. F. *Proc. Acad. Nat. Sci. Philadelphia*, pp. 171–174. 1877.
14. COPE, E. D., and PACKARD, A. S. *Am. Nat.* Vol. xv, pp. 877–882, Pl. VII. 1881.
15. FAXON, W. *Proc. Am. Acad. Arts and Sci.* Vol. xx, pp. 107–158. 1884.
16. FAXON, W. *Mem. Mus. Comp. Zoöl.* Vol. x, No. 4. 1885.
17. FAXON, W. *Bull. Mus. Comp. Zoöl.* Vol. xvii, No. 6, p. 237, Pls. I and II. 1889.
18. FAXON, W. *Proc. U. S. Nat. Mus.* Vol. xii, pp. 619–634. 1890.
19. HAY, W. P. *Proc. U. S. Nat. Mus.* Vol. xvi, pp. 283–286. 1893.
20. LÖNNBERG, EINAR. *Bihang Till K. Sven. Vet.-Akad. Handlingar.* Bd. xx, Afd. iv, No. 1. 1894.
21. HAY, W. P. *Twentieth Ann. Rept. Ind. Geol. Survey*, pp. 475–507. 1896.
22. BOUVIER, E. L. *Bull. Mus. d'Hist. Nat. Paris*, No. 6, p. 224. 1897.
23. FAXON, W. *Proc. U. S. Nat. Mus.* Vol. xx, pp. 643–694. 1898.
24. HAY, W. P. *Proc. U. S. Nat. Mus.* Vol. xxii, pp. 121–123. 1899.

LIST OF SPECIES WITH DISTRIBUTION.

ASTACUS,

Distribution limited to the Pacific watershed.

A. gambelli, Utah, Idaho, Montana.

A. nigrescens, San Francisco to Alaska (near coast).

A. leniusculus, Columbia R.

A. trowbridgii, Columbia R.

A. klamathensis, region about Klamath R. and L.

CAMBARUS,

Distribution limited to Atlantic watershed except in Mexico.

The following natural groups of the crayfishes of Eastern North America are recognized:

1 First pair of abdominal appendages of the male clavate; the outer part truncate at the tip and provided with one to three curved teeth; the inner part terminated by a short acute curved spine.

Third segment of third and fourth pairs of legs of males hooked. ("Group I" of Faxon)

C. blandingii, N. Y. to Ala.
C. blandingii acutus, Ala., Tex., Ind.
C. fallax, Fla.
C. hayi, Miss.
C. clarkii, Tex. to Fla.
C. troglodytes, Ga. to S. Car.
C. lecontei, Ala., Ga.
C. angustatus, Ga.
C. pubescens, Ga.
C. spiculifer, Ga.
C. versutus, Ala., Fla.
C. alleni, Fla.
C. evermanni, Fla.
C. barbatus, Ga.
C. wiegmanni, Mex.
C. pellucidus, Ind., Ky. (Caves).
C. pellucidus testii, Ind. (Caves).
C. acherontis, Fla. (Caves).

Third segment of third pair of legs of males hooked. ("Group II" of Faxon)

C. simulans, Tex., Kan.
C. mexicanus, Mex.
C. advena, S. Ga.
C. gracilis, Ind., Ill., Mo. (?).
C. carinatus, Mex.
* *C. cubensis*, Cuba.
C. carolinus, S. Car., Tex.
(?) *C. clypeatus*, S. Miss.

2 First pair of abdominal appendages of the male terminated with two falcate teeth, the larger of which belongs to the outer part of the appendage, the smaller to the inner part. Third segment of third pair of legs of males hooked. ("Group III" of Faxon)

C. bartonii, N. B., Mo., N. C., Tenn.
C. bartonii robustus, Dom. Can., Ill.
C. longulus, Va., N. C., Tenn.
** *C. longulus longirostris*, Va., Ala., Tenn.
C. dubius, W. Va., Tenn.
C. uhleri, Md. ("eastern shore")
C. latimanus, S. C., Tenn., Miss.
C. acuminatus, S. C., N. C.
C. girardianus, N. Ala.
C. extraneus, N. Ga.
C. jordani, N. Ga.
C. argillicola, Dom. Can., N. C., La.
C. diogenes, N. J., Wy., Miss.
C. diogenes ludovicianus, La.
C. cornutus, Ky.
C. hamulatus, Nickajack Cave.
C. setosus, Caves in S. W. Mo.

* *C. cubensis* = *C. consobrinus* Sauss.
** = *C. bartonii longirostris* Fax.

3 First pair of abdominal appendages of the males furciform, terminating in two elongated nearly straight, acute tips. Third segment of third pair of legs of males hooked. ("Group IV" of Faxon)

C. lancifer, Miss., Ark.
C. affinis, S. N. Y., Va., L. Superior.
C. indianensis, S. Ind.
C. sloanii, S. Ind., Ky.
C. propinquus, Dom. Can., Minn.
C. propinquus obscurus, N. Y., Pa.
C. propinquus sanbornii, Ky., Ohio.
C. neglectus, Kan., Mo.
C. harrisonii, Mo.
C. virilis, Dom. Can., Tex., Kan.
C. immunis, N. Y., Wy., Tex.
C. immunis spinirostris, Tenn., Neb.
C. hylas, Mo.
C. pilosus, Kan.
C. nais, Kan.
C. mississippiensis, Miss.
C. palmeri, Tenn., Ind. Terr.
C. palmeri longimanus, Ind. Terr., Tex.
C. longidigitus, Ark.
C. difficilis, Ind. Terr., Ark.
C. meekii, Ark.
C. erichsonianus, Tenn., Ala.
C. alabamensis, N. Ala.
C. compressus, N. Ala.
C. medius, Mo.
C. rusticus, Pa., Ia., Tex.
C. spinosus, S. C., N. Ala.
C. putnami, Ky., Ind.
C. forceps, N. Ala., Va., Tenn.
C. digueti, Mex.

Third segment of second and third pairs of legs of males hooked. ("Group V" of Faxon)

C. montezumæ, Mex.
C. montezumæ dugesii, Mex.
C. montezumæ areolatus, Mex.
C. montezumæ occidentalis, Mex.
C. shufeldtii, La.
C. chapalanus, Mex.

Astacus.—Last thoracic somite bearing a gill on each side, thus making eighteen gills (plus two or three rudiments) in each branchial chamber. Orifice of green gland on posterior face of tubercle. First abdominal appendages of males neither toothed nor bifid at the apex and none of the thoracic legs with hooks. Annulus ventralis represented by a transverse ridge.

1 Margins of rostrum denticulate 2
1 Margins of rostrum smooth 3
2 Chelæ with a patch of soft setæ on outer face . . *A. gambelli* Gir.
2 Chelæ naked on outer face . . . . . *A. nigrescens* Stimp.
3 Postorbital ridges with a posterior spine or tubercle 4
3 Postorbital ridges without a posterior spine or tubercle *A. klamathensis* Stimp.
4 Acumen longer than distance between lateral teeth of rostrum *A. leniusculus* Dana
4 Acumen not longer than distance between lateral teeth of rostrum *A. trowbridgii* Stimp.

Cambarus. — Last thoracic segment without a gill, thus reducing the number in each branchial chamber to seventeen. Orifice of green gland at apex of tubercle. First abdominal appendages of males bifid and hooked or toothed at the apex. One or more pairs of thoracic legs of males with a hook-like tubercle on the third segment. In the females, annulus ventralis developed as a depressed cone on the sternum between the bases of the last pairs of legs.

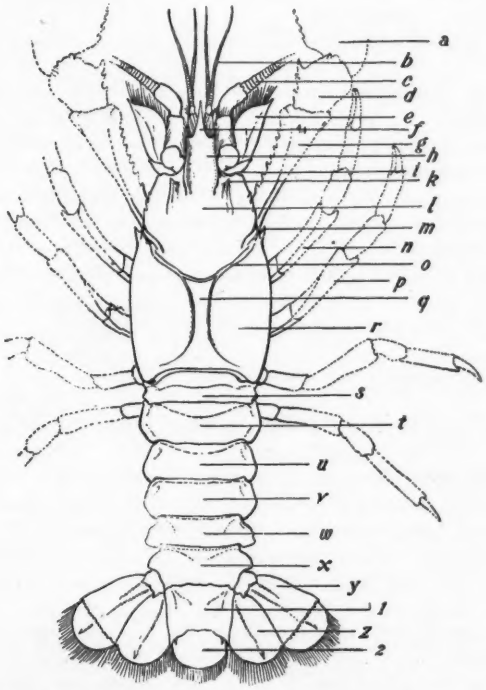
1 Eyes normally developed 2
1 Eyes atrophied 84
2 Areola very narrow or obliterated 3
2 Areola of moderate or excessive width 18
3 Rostrum with lateral spines 4
3 Rostrum without lateral spines 11
4 Rostrum excessively lengthened, the posterior portion of carapace one-third as long as anterior . . . . . *C. lancifer* Hag.
4 Rostrum not excessively lengthened, posterior portion of carapace more than one-third as long as anterior 5
5 Rostrum with a low median longitudinal carina . *C. palmeri* Fax.
5 Rostrum without a carina 6
6 Sides of carapace coarsely granulate; inner finger of chelæ markedly sinuate 81
6 Sides of carapace slightly granulate or smooth 7
7 Areola obliterated for at least a portion of its length . . . 8
7 Areola not obliterated at any point 9
8 First abdominal appendages of males with slender, nearly straight, acute tips. Annulus ventralis of females with a pronounced central fossa . . . . . *C. palmeri longimanus* Fax.
8 First abdominal appendages of males with short recurved tips. Annulus ventralis of females with the central fossa almost obliterated *C. difficilis* Fax.
9 Lateral teeth of rostrum small . . . . . *C. nais* Fax.
9 Lateral teeth of rostrum strong 10
10 Anterior border of carapace angulated below the eye *C. longidigitus* Fax.
10 Anterior border of carapace not angulated . . *C. pilosus* Hay
11 Base of rostrum not foveolate . . . . . *C. advena* LeC.
11 Base of rostrum with a more or less pronounced foveola . . . 12
12 Anterior border of carapace angulated below the eye . . . 13
12 Anterior border of carapace not angulated below the eye . . 15
13 Areola linear but not obliterated . . . . *C. gracilis* Bun.
13 Areola obliterated in the middle 14
14 Sides of rostrum straight . . . . . *C. diogenes* Gir.

14 Sides of rostrum concave . . *C. diogenes ludovicianus* Fax.
15 Areola linear but not obliterated 16
15 Areola obliterated in the middle 17
16 Rostrum short, slightly longer than broad . *C. carolinus* Erich.
16 Rostrum twice as long as broad . . *C. mississippiensis* Fax.
17 Upper surface of rostrum plane and faintly carinate *C. uhleri* Fax.
17 Upper surface of rostrum excavated, not carinate *C. argillicola* Fax.
18 Rostrum with lateral teeth 19
18 Rostrum without lateral teeth 63
19 Sides of carapace with two spines just behind the cervical groove . 20
19 Sides of carapace with only one spine or unarmed 21
20 Proximal segment of telson with three or four spines on each side of the posterior border . . . . . *C. versutus* Hag.
20 Proximal segment of telson with only two spines *C. spiculifer* LeC.
21 Rostrum with a more or less pronounced median longitudinal carina above 22
21 Rostrum without a carina 29
22 Proximal segment of telson with three spines on each side *C. carinatus* Fax.
22 Proximal segment of telson with only two spines on each side . . 23
23 Sides of carapace with a spine 24
23 Sides of carapace unarmed . . . . *C. compressus* Fax.
24 Outer finger of chela bearded at base on inner margin . . . 25
24 Outer finger of chela not bearded 26
25 Rostrum slightly excavated, carina broad, low, and rounded *C. alabamensis* Fax.
25 Rostrum deeply excavated, carina very faint . . *C. meeki* Fax.
26 Rostrum slightly excavated (broad and nearly plane above) *C. neglectus* Fax.
26 Rostrum well excavated (narrower and deeply grooved) . . . 27
27 Postorbital spine strong . . . . . *C. meeki* Fax.
27 Postorbital spine weak 28
28 Rostrum with a low carina . . . . . *C. propinquus* Gir.
28 Rostrum with a high, sharp carina . . . . *C. digueti* Bouv.
29 Flagellum of antenna excessively flattened and heavily ciliate along the inner margin . . . . . *C. cornutus* Fax.
29 Flagellum of antenna normal 30
30 Carapace without lateral spines 31
30 Carapace with lateral spines 39
31 Sides of rostrum straight or concave 32
31 Sides of rostrum convex 34
32 Postorbital spines small or wanting . . . . *C. virilis* Hag.
32 Postorbital spines well developed 33
33 Areola broader . . . . . *C. rusticus* Gir.

33 Areola narrower . . . . . *C. meeki* Fax.
34 Postorbital spines wanting 35
34 Postorbital spines present 36
35 Sides of rostrum converging uniformly to the apex, no acumen *C. montezumæ occidentalis* Fax.
35 Sides of rostrum angulated or slightly toothed near the apex, thus defining an acumen . . . . . *C. montezumæ* Sauss.
36 Rostrum long and slender, with stout, sharp lateral spines and slender acumen ; postorbital spines strong . . *C. chapalanus* Fax.
36 Rostrum of medium length, with small lateral teeth and short, broad acumen ; postorbital spines small 37
37 Sides of rostrum raised as sharp ridges . *C. montezumæ dugesii* Fax.
37 Sides of rostrum not raised as sharp ridges 38
38 Branchiostegal spine not developed *C. montezumæ areolatus* Fax.
38 Branchiostegal spine developed but small . . *C. cubensis* Erich.
39 Posterior portion of carapace considerably less than half as long as anterior portion 40
39 Posterior portion of carapace half or nearly half as long as anterior portion 42
40 Areola wide 41
40 Areola rather narrow . . . . . *C. lecontei* Hag.
41 Proximal segment of telson with three spines on each side *C. angustatus* LeC.
41 Proximal segment of telson with four spines on each side *C. pubescens* Fax.
42 Anterior border of carapace with a projecting angle below the eye . 43
42 Anterior border of carapace not angulated 54
43 Suborbital angle spinulose 82
43 Suborbital angle not spinulose 44
44 Rostrum nearly plane above 45
44 Rostrum well excavated 46
45 Acumen long . . . . . *C. jordani* Fax.
45 Acumen rather short (size small) . . . . *C. shufeldtii* Fax.
46 Areola narrow 47
46 Areola of moderate or excessive width 48
47 Margins of rostrum concave . . . . . *C. meeki* Fax.
47 Margins of rostrum slightly convex . *C. immunis spinirostris* Fax.
48 Areola wide . . . . . *C. sloanii* Bun.
48 Areola of moderate width 49
49 Acumen of rostrum short 50
49 Acumen of rostrum not short 51
50 Lateral teeth of rostrum well developed but short, sides of rostrum nearly parallel . . . . . *C. blandingii* Har.
50 Lateral teeth of rostrum poorly developed, sides of rostrum convergent *C. blandingii acutus* Gir.

51 Anterior portion of carapace a very little more than twice as long as anterior portion . . . . . *C. spinosus* Bun.
51 Anterior portion of carapace not more than twice as long as posterior portion 52
52 Rostrum faintly carinate . . . . . *C. forceps* Fax.
52 Rostrum not carinate 53
53 Acumen of moderate length . . . . . *C. hylas* Fax.
53 Acumen long and slender . . . . . *C. putnami* Fax.
54 Sides of rostrum concave 55
54 Sides of rostrum not concave 57
55 Lateral spines of carapace strong . . . *C. indianensis* Hay
55 Lateral spines of carapace small or obsolete 56
56 Postorbital spines well developed . . . . *C. harrisonii* Fax.
56 Postorbital spines small or obsolete . . . *C. rusticus* Gir.
57 Lateral spines of carapace strong 58
57 Lateral spines of carapace small and weak 60
58 Sides of rostrum nearly parallel, acumen long and rather slender . 59
58 Sides of rostrum convergent, acumen short . . . *C. hayi* Fax.
59 Postorbital spines strong, sides spiny . . . *C. affinis* Say.
59 Postorbital spines small, sides not spiny . . *C. erichsonianus* Fax.
60 Proximal segment of telson with three or four spines on each side *C. fallax* Hag.
60 Proximal segment of telson with only two spines on each side . . 61
61 Rostrum deeply excavated . . *C. propinquus sanbornii* Fax.
61 Rostrum slightly excavated or subplane 62
62 Tip of acumen abruptly turned upward . . . *C. virilis* Hag.
62 Tip of acumen gently curved upward . . . *C. obscurus* Hag.
63 Carapace with one spine on each side just behind cervical groove . 64
63 Carapace without lateral spines 67
64 Postorbital and branchiostegal spines well developed . . . 65
64 Postorbital and branchiostegal spines small or wanting . . . 66
65 Areola narrow . . . . . *C. wiegmanni* Erich.
65 Areola broad . . . . . *C. acuminatus* Fax.
66 Base of rostrum slightly foveolate . . . . *C. immunis* Hag.
66 Base of rostrum not foveolate . . . . . *C. virilis* Hag.
67 Branchiostegal spine developed 68
67 Branchiostegal spine wanting 74
68 Anterior border of carapace decidedly angulated below the eye . 69
68 Anterior border of carapace hardly angulated 73
69 Proximal segment of telson with three or four spines on each side . 70
69 Proximal segment of telson with only two spines on each side . 71
70 Rostrum pubescent and nearly flat above . *C. mexicanus* Erich.
70 Rostrum not pubescent, deeply excavated . . *C. alleni* Fax.
71 Inner surface of hands with a more or less thick covering of soft setæ *C. barbatus* Fax.

71 Inner surface of hands not setose 72
72 Cervical groove broken on the sides . . . *C. virilis* Hag.
72 Cervical groove not broken on the sides . . *C. latimanus* Erich.
73 Areola carinate . . . . . *C. simulans* Fax.
73 Areola not carinate 83



Outline drawing of Cambarus affinis ♂ showing most of the structures mentioned in the diagnosis of the species of crayfishes. *a*, chela; *b*, 1st antenna (antennules); *c*, 2d antenna (antenna); *d*, carpus (of chelaped); *e*, antennal scale; *f*, acumen (of rostrum); *g*, meros (of chelaped); *h*, rostrum; *i*, suborbital angle; *k*, postorbital spine and ridge; *l*, anterior (gastric) portion of carapace; *m*, lateral spine (of carapace); *n*, second pair of legs; *o*, cervical groove; *p*, third pair of legs; *q*, areola; *r*, posterior (branchio-cardiac) portion of carapace; *s*, *t*, *u*, *v*, *w*, *x*, segments of abdomen; *y*, *z*, outer and inner blades of caudal fin; *1*, *2*, proximal and distal segments of telson.

74 Rostrum with a longitudinal median carina above . *C. medius* Fax.
74 Rostrum not carinate 75
75 Rostrum deeply excavated 76
75 Rostrum not deeply excavated 77
76 Rostrum strongly decurved, areola narrow . . *C. dubius* Fax.

76 Rostrum not strongly decurved, areola not narrow . *C. virilis* Hag.
77 Rostrum long, antennal scale long and broad . *C. montezumæ* Sauss.
77 Rostrum short, antennal scale short and narrow 78
78 Edges of rostrum swollen and raised, fingers gaping widely at base, outer finger more or less bearded within at base. . . . 79
78 Edges of rostrum not swollen, fingers not widely gaping at base, outer finger not bearded 80
79 Spines of postorbital ridges weak; suborbital angle not produced *C. longulus* Gir.
79 Spines of postorbital ridges strong; suborbital angle produced, almost spiniform . . . . . *C. longulus longirostris* Fax.
80 Carapace depressed, sides gently curving toward front and rear; hands not impressed . . . . . *C. bartonii* Fab.
80 Carapace cylindrical, sides nearly parallel as far forward as cervical groove, then curving abruptly to base of rostrum. Hands strongly impressed . . . . . *C. bartonii robustus* Gir.
81 Rostrum of medium length, well excavated, lateral teeth strong *C. clarkii* Gir.
81 Rostrum short, almost flat above, lateral teeth small *C. troglodytes* LeC.
82 Distal end of meros with one small spine on superior surface *C. girardianus* Fax.
82 Distal end of meros with two strong spines on superior surface *C. extraneus* Hag.
83 Proximal segment of telson with two spines on each side *C. evermanni* Fax.
83 Proximal segment of telson with four or more spines on each side *C. clypeatus* Hag.
84 Areola broad and long, with parallel sides; carapace nearly smooth, very lightly granulate on the sides 85
84 Areola narrow, with curved sides; carapace roughly granulate on the sides at least 87
85 Rostrum foveolate at base . . *C. hamulatus* Cope and Pack.
85 Rostrum not foveolate 86
86 Sides of carapace spiny . . . . . *C. pellucidus* Tellk.
86 Sides of carapace unarmed . . . . *C. pellucidus testii* Hay
87 Sides of carapace granulate and setose; no lateral or postorbital spines; areola very narrow . . . . . *C. setosus* Fax.
87 Sides of carapace tuberculate; lateral and postorbital spines developed; areola linear . . . . . *C. acherontis* Lönn.

REVIEWS OF RECENT LITERATURE.

GENERAL BIOLOGY.

A Rational Vitalism. — A most significant feature of the biological thought of to-day is the effort to place upon a solid foundation the idea of elementary vitalistic phenomena as thinkable processes, which are independent of all known chemical and physical forces and as worthy of scientific recognition and as capable of exact statement as is gravitation or chemical affinity.

Driesch in a recent paper[1] seeks to furnish a proof of the existence of vitalistic phenomena of an elementary character, not by bringing forward new facts, but by the interpretation of already published observations in the domain of experimental morphology. It should be at once mentioned that, whereas Driesch combats strongly the absolute dominance of the mechanical theory of life processes, as confusing that which is merely understandable with that which is actual and capable of proof, and so as becoming dogmatic and misleading, he clearly discountenances the older uncritical vitalism with its implied supernatural teleology and its absence of all well-defined relation to the fundamental ideas of causality, energy, matter, etc.

The author looks to the problem of localization of morphogenetic processes as the divining rod by the aid of which we may be led into this new land of promise. Why is it that the archenteron of the well-developed gastrula of Sphærechinus becomes constricted in two places, thus marking off from one another the stomadæum, mesenteron, and proctodæum? Moreover, why do similar constrictions occur in the archenterons of each of the two half embryos, which result from the dividing in the equatorial plane of a well-developed gastrula in such wise that each half contains its share of the endoderm as well as of ectoderm? The wound heals, and the constrictions occur in each embryo at the same proportionate distances from the poles of the embryo as in the normal larva. The cause of this phenomenon, and of others similar to it, is not to be found,

[1] Driesch, H. *Die Localisation morphogenetischer Vorgänge: Ein Beweis vitalistischen Geschehens.* Leipzig, 1899. 82 pp. Published also in *Archiv für Entwicklungsmechanik*, etc., Bd. viii, 1, pp. 35–111, 1899.

according to the author, in any known chemical or physical force, but in an hypothetical *Fernkraft*, an elementary vital force which acts at definite distances from fixed points, like the active pole of the egg, or from the median-ventral line of the bilaterally symmetrical embryo, to determine in some definite manner the form.

Various localization problems of a special nature are discussed. Treating of cleavage among the echinoderms, the author deduces from his own and others' experiments upon the segmentation of egg fragments and of isolated blastomeres, the displacement of blastomeres, etc., the conclusion that the protoplasm of the egg, in general, depends upon a certain factor, inherent in the protoplasm, upon which the cleavage and a general regulation of the egg mass depend, and he also asserts as proved the proposition that all parts of the cytoplasm during segmentation are respectively similar as regards their morphological "prospective potency," and that the nuclei are likewise similar each to each. From this standpoint he reasons that the earliest differentiation of the embryo is determined as to its position by a correlating force, this conclusion being quite opposed to the idea that the protoplasm of the egg consists of manifold elements arranged in some sort of a typical specific position, which bears a certain definite relation to later differentiation. If then the structure of the egg consists, as is assumed, merely of a polarity, namely the possession of a chief axis with unlike poles and one at right angles to it which also has unlike poles, how can one explain the localization of a variety of structures in the embryo not only at the poles but at any possible, though typical, position in the embryo? Likewise the arrangement of the bilateral groups of mesenchyme in the echinoids in definite typical positions, the appearance of the mouth in its proper place, independently of any possible contact stimulus proceeding from the archenteron, the localization of the ciliated band of Bipinnaria, all are problems of localization of a similar nature.

The eggs of ctenophores and of mollusks naturally present certain difficulties, since in them no regulation of the entire egg mass is proved and a definite complex structure of formative materials within the ovum is conceivable. Nevertheless the author believes that the power is there, though dormant, and that a sort of precocious activity of the localizing force may explain the difference between these eggs and those of the echinoderms, Amphioxus, etc. Moreover, if a complicated structure is assumed for the ovum of the ctenophore or of the mollusk, then the very structure of such typical complex nature presupposes in oögenesis a localizing agency.

Another well-marked case in which this same phenomenon is manifest is the "reparation" of Tubularia. How is it that the two circlets of buds of the new hydranth arise not on the surface of the wound of the transsected hydrocaulus, but always at a definite distance from that surface?

Finally, the results of Morgan's experiments upon regeneration in Planaria, which show that each of the several pieces cut from one individual becomes transformed by a shifting and differentiation of the protoplasm into a small and typically proportioned worm, likewise demand for an interpretation some controlling factor with localizing power.

In a discussion of the idea of localization in general, it is shown that the phenomenon of determination of position of parts may or may not require for its explanation the postulate of a localizing force of an elementary kind. In many instances of localization phenomena among plants, as in the transformation of indifferent leaf germs into foliage leaves or bud scales by the influence or absence of light, the localizing power consists in the direct action of a definite external stimulus upon parts which possess equal, though restricted, possibilities. In such cases as this, and in ordinary regeneration among animals, like the restoration of an amputated leg in Triton, localization is determined by the nature and position of the external stimulus (light, heat, etc.) or by the limited "potency" of the parts. Therefore no localizing action of an elementary nature occurs in these instances.

It is shown that the localization phenomena which are independent of specific external stimuli and of a simple elementary nature are confined to that association of cells or elementary structures of whatever kind which Driesch terms a harmonic equipotential system. In an equipotential system, in general, every part has an equal "prospective potency" with every other, *i.e.*, equal power as to the possibilities of its development. The willow twig, for example, is an equipotential system in which every part has indeed an equal prospective potency with every other; but here the power is limited to the production of sprouts and roots that are indefinite in number and have no specific relation to one another. An equipotential system which is thus restricted in its possibilities is called a determined equipotential system. In the segmenting egg of an echinoid or in the stem of Tubularia, however, every "effect" appears only once or a limited number of times, and stands in a definite relation to all other "effects." Such are accordingly called harmonic equipotential

systems, and it is the phenomena of localization which occur in such systems that require an elementary vitalistic force for their explanation. An organization as regards primary axial relations, which is present at the beginning of development, is considered to be an essential part of the conditions of every harmonic equipotential system, and it is therewith an essential presupposition of its differentiation. Moreover, the activities which occur in such a system as the result of some disturbance of the course of development indicate the existence of a regulatory power, which is a fundamental character that is intimately associated with the localization of differentiation.

In defining formally the localizing action which takes place in harmonic equipotential systems, Driesch makes first a statement in terms of cause and effect. Thus we may suppose one of the terminal points of the axis of any structure under consideration to be the seat of forces which act at a distance. This place may be said to exert an influence, to which that part upon which it works must be able to respond. Reverting to the constriction of the archenteron of the gastrula of echinoderms, the author claims that the cause of the constrictions lies in the "potency" of the system; the *Fernkraft*, acting through a definite typical distance, determines where the constrictions shall be. The distance, however, is not absolute, but proportionate to the size of the system. As the system becomes modified and more complicated, new points of reference are formed, from which still other sorts of *Fernkraft* act. If the formation of the mouth of the larva of echinoids be taken as another example, the force in question is presumed to operate from the anterior and posterior poles, and at a certain proportionate distance between them; its localization in the median ventral line depends upon the primary bilateral orientation of the whole embryo, which results in the taking on of a unique and special character by that line. The writer shows furthermore that this localizing force may act not only upon the surface of a sphere or other curved surface, but also upon the area between two concentric spheres, etc.

In treating of the relations of the effect (*viz.*, the action of localization) to the cause (the postulated force), Driesch shows that conditions obtain which are very different from those of purely physical or chemical transformations, for the cause is neither transferred quantitatively to the effect, as in mechanical and physical action, nor does it reappear in the effect as a product of the reaction, as in chemical transformations. In the case at hand every specific cause (acting in reference to quantity, *i.e.*, distance) has a corresponding

effect in localization, making possible the attainment of a given end. Such a process Driesch calls undetermined adaptive action or a phenomenon of response.

The author furthermore seeks a functional representation of the events which occur when the course of development is disturbed by an experiment and in which localization phenomena are, of course, implied. That which happens is found to be a function of (1) the final condition (toward which normal development proceeds) and of the condition of the embryo immediately (2) before and (3) after the disturbing act; and, since the third factor is a variable, the process as a whole is of a variable nature. A certain "teleology" is implied in these events and in all ontogenetic processes in that they are the means toward specific ends. Thus the events which follow any disturbance of development are characterized as being dependent upon the final condition. The regulatory phenomena which attend disturbances of mechanical systems, on the other hand, are of a quite different nature, since they are independent of any final condition and depend wholly upon factors that are constant.

Finally, the action of localization is found to be dependent upon the absolute size of the system (G), upon the local relations that exist in the complete absolute-normal system (R), and on the primary orientation in reference to a definite system of coördinates. If the last factor is assumed to be known, then xyz (the place) $= \phi\,[G.R]$. This formula is found not to be applicable to inorganic bodies, since in them the localization of specific details of structure is determined by the direct action of external forces without reference at all to the absolute size of the system.

Enough has been shown of Driesch's excellent discussion of these difficult problems of localization to enable the reader to foresee the final conclusion of the author: Since there exists in the processes of ontogenetic differentiation this group of phenomena which are not subordinate to any known laws of inorganic matter, but which make it necessary to assume a special definite elementary action in accordance with fixed laws, it may be regarded as proved that Vitalism, *i.e.*, that conception which sees in life processes events with elementary laws which are peculiar to organic beings, now stands upon a firm foundation.

After a careful study of this important paper the reader will perhaps feel the insufficiency of the postulated localizing *Fernkraft* in itself. Of all that is implied in the "potency" of a "harmonic equipotential system," he would know more. A lingering doubt perhaps

remains in the reader's mind as to whether a fuller knowledge of the "potency" might make the supposition of the *Fernkraft* unnecessary. Cannot formative material operated by chemical and physical forces yet furnish a solution of the problem? Before one is quite converted from the dogmatic materialism of the day to the rational vitalism of Driesch, it is fitting to know well the grounds of the new belief. The phenomena of localization are most admirably analyzed and discussed in the paper under consideration. Other general questions therein implied, as, for instance, Prospective Potency, are ere long to receive, we are informed, a fuller definition and discussion. These further studies will be awaited with much interest.

JOHN H. GEROULD.

Praxis und Theorie der Zellen- und Befruchtungslehre.[1]— This is a book of 260 pages, with 137 text-figures, and is designed to be a practical guide for courses in cytology. As such it cannot fail to be of service, since it is the first work yet published with this distinctive aim. There is, to be sure, in Bergh's *Zelle und Gewebe* an appendix on technique, but this is no more extensive than may be found in many text-books of histology, while the larger works of Hertwig, Wilson, and Henneguy present the facts and theories with regard to the cell from a general rather than from a laboratory standpoint.

As the title indicates, the book also presents in brief form the general facts and theories of cytology, together with a short historical review of different phases of the subject and references to some of the more important literature. This feature of the work, however, lacks the completeness and critical character of the larger works devoted to this field, while the laboratory directions are so interwoven with the general part as to make the book much less readable than the other works mentioned. Unfortunately this combination also renders the book less useful as a laboratory guide, since the directions for preparing and observing material are less concise and explicit, and are much more difficult to find than would otherwise be the case.

The book is the outgrowth of a practical course on the cell given at the Zoölogical Institute at Freiburg, and in conformity with this course the contents are divided into sixteen days, two or three objects being considered each day. The subject for each day and the objects of study are as follows: First Day, Plant and animal

[1] Hacker, Dr. Valentin. Jena, Gustav Fischer, 1899, 7 marks.

tissue cells: Objects, stamen hairs of Tradescantia, epidermis of larval salamander. Second Day, Unicellular organisms: Objects, Amœba, Pelomyxa, Stylonichia. Third Day, Resting nuclei; nuclear reticulum and nucleoli: Objects, living nuclei from the urinary bladder of Salamandra, ovarian eggs of Siredon and Triton. Fourth Day, Chemistry of the cell nucleus: Objects, sperm of salmon and trout, leaf epidermis of Leucojum. Fifth Day, Physiology of the cell nucleus: Objects, Stentor, root hairs of seedlings of pea, egg tubes of Dytiscus. Sixth Day, Cell division, (*a*) Chromatic Figure: Objects, epithelium from cornea and tail of larval salamander, peripheral protoplasmic layer of the embryo sac of Fritillaria, testis of salamander. Seventh Day, Cell division, (*b*) Achromatic Figure: Fertilized eggs of Ascaris, uterine eggs of Thysanozoön. Eighth Day, Centrosomes: Objects, eggs of Cyclops, pigment cells of the corium of the pike, winter eggs of Sida. Ninth Day, Oögenesis, (*a*) Germinal Vesicle: Objects, ovary of Canthocamptus and of other fresh-water copepods. Tenth Day, Oögenesis, (*b*) Germinal Spot and Yolk Nucleus: Objects, ovarian eggs of fresh-water mussel, fertilized eggs of Myzostoma, ovarian eggs of Tegnaria and Pholcus. Eleventh Day, Oögenesis, (*c*) Polar-body Formation: Objects, fertilized eggs of starfish, uterine eggs of Ascaris. Twelfth Day, Spermatogenesis: Objects, sperm tubes of Ascaris, testis of salamander. Thirteenth Day, Reduction divisions: Objects, oviducal eggs of Diaptomus, uterine eggs of Thysanozoön, laid eggs of Cyclops. Fourteenth Day, Fertilization of the metazoön egg: Objects, living eggs of Diplogaster and Rhabditis, eggs of sea urchin, uterine eggs of Ascaris. Fifteenth Day, Fertilization, further facts and theories: Objects, bastard larvæ of sea urchin, Antherozoids of the Fern, bastard larvæ of Echinus and Sphærechinus (including Boveri's famous experiment on the fertilization of enucleated eggs), results of crossing white mice with the Japanese house mice. Sixteenth Day, Cells of the germ tracks: Objects, uterine eggs of Ascaris, eggs of *Cyclops brevicornis*.

The subjects considered show that the field is well covered, while the objects taken up for study on some of the days would indicate that the "day" is to be interpreted in the Biblical sense. The most notable omission from the practical work is the whole subject of the cleavage of the egg, in which are illustrated, as perhaps nowhere else, the various kinds of cell division (equal, unequal, differential, etc.), the mechanics of cell division, experimental modifications of cleavage, and the promorphology of the ovum. These subjects are briefly

discussed under the fertilization of the egg, but no practical work is suggested. Some of the objects suggested for study are not of sufficiently wide or abundant occurrence to make them generally accessible, *e.g.*, the eggs of Thysanozoön, Sida, Myzostoma, Siredon, and the repetition of Boveri's experiment on the fertilization of enucleated egg fragments. In spite of these limitations, the work will be of great value to all who are giving courses on practical cytology.

Davenport's Statistical Methods.[1] — This work is intended to meet "the call for a simple presentation of the newer statistical methods in their application to biology," and seems an admirable handbook for the purpose. It consists of definitions and explanations of methods, including "the seriation and plotting of data and the frequency of the polygon," etc., with a selected bibliography of the subject, the whole occupying less than fifty pages, followed by about one hundred pages of formulas and logarithmic tables. Chapter V (pp. 38, 39) gives "Some Applications of Statistical Biological Study." While the "newer statistical methods" are admirably suited to the investigation of certain special problems, which may be of the highest interest and importance, they seem too minute and detailed, and to require the expenditure of too much time and labor, to be of very broad application, such as the author apparently contemplates. Thus, it is said: "The origin of species through geographical segregation can be studied by the determination of *place-modes;* that is, the modal condition of specific characters of one and the same species in various localities. The progress of specific differentiation will be measured by the change in place-modes from decade to decade, or by the formation of a binomial curve in the place of a modal one; by the gradual separation of the two modes of a binomial curve." Theoretically this is possible, but taking into account what it implies, even for a single species, does it not border on the chimerical, or at least on the impracticable? First is necessarily involved a geographical area of considerable extent — at least hundreds of miles square, under ordinary conditions of topography — within which many observation stations must be chosen, and at which work must be continued "from decade to decade," and detailed measurements made of every measurable feature of many

[1] *Statistical Methods* with special reference to Biological Variation. By C. B. Davenport, Ph.D., Instructor in Zoölogy at Harvard University. First edition. First thousand. New York, John Wiley & Sons. London, Chapman & Hall, Limited, 1899. — 12mo, 148 pp.

thousands of individuals. And this not only for one species but for a whole fauna, as: "A basis for an arbitrary *distinction between species and varieties* may be gained by determining a degree of divergence and of isolation which shall be used to distinguish the two. A degree of divergence of thrice the standard deviation has been suggested as a convenient line between species and varieties." The idea of such a broad application of the "newer statistical methods," and for such purposes, seems at present Utopian, because simply impracticable. Again, an arbitrary standard of deviation which may be perfectly legitimate for one group, as a genus or family, would prove inapplicable for another group of similar grade within even the same class.

As already said, the scheme is theoretically admirable, and is no doubt applicable to many special problems, but is too costly in time, material, and labor to be of the wide or general applicability in determining species and subspecies, or the methods and causes in the segregation of geographic forms, apparently contemplated by the author of the present manual. The gross methods already in vogue, being tolerably efficient for temporary and tentative purposes, will probably hold the field for a while at least, so that it will be in the remote future when, through the plotting of curves and the use of logarithmic tables, we shall see "by the use of the quantitative method biology . . . pass from the field of the speculative sciences to that of the exact sciences" (p. 39).

J. A. A.

The question of the former existence of an Antarctic continent with a flora and fauna of its own, the remnants of which are still recognizable in the southern continents, has been brought into prominence recently, and we should like, in this connection, to call attention to a paper published in Australia that, although issued four years ago, has not been noticed sufficiently in other countries. C. Hedley[1] starts from the fact mentioned already by early travelers, that Tasmania, Australia, New Zealand, South America, and partly also South Africa contain certain forms of life in common which are not represented elsewhere, and concludes that this community of type cannot be explained but by community of origin, and that we have to look for a connection of these now separated parts by former land bridges.

After discussing and criticising the theory of Hutton, which con-

[1] Hedley, C. Considerations on the Surviving Refugees in Austral Lands of Ancient Antarctic Life, *Roy. Soc. N. S. Wales.* Aug. 7, 1895.

structs this bridge across the South Pacific from Chile to Samoa and thence to New Zealand, that of Forbes, which assumes an immense Antarctic continent, and that of Pilsbury and v. Ihering, which accounts for the similar forms in South America, Tasmania, and Australia by the hypothesis of a former more extensive Austral continent which subsequently became united with South America at Cape Horn, Hedley gives his own solution of the problem. He says that "during the Mesozoic or older Tertiary, a strip of land with a mild climate extended across the South Pole from Tasmania to Terra del Fuego, and that Tertiary New Zealand then reached sufficiently near to this Antarctic land, without joining it, to receive by flight or drift many plants and animals." This "Antarctica" was of an unstable character, "at one time dissolving into an archipelago, at another resolving itself into a continent." Thus a deep gulf extended from Tasmania to Cape Horn, stretching within a few degrees of the pole, and this assumption would tend to explain some facts of distribution of marine shallow-water animals.

It seems to us that this theory has some advantage over the other theories mentioned, yet it is perhaps premature to form a distinct idea as to the connection of the southern ends of the present continents. That such was present before or at the beginning of Tertiary times seems to be beyond doubt, but for the actual construction of this bridge the data at hand seem to be too imperfect. But this much we may safely assume, as Hedley does, that this bridge was no constant and solid mass all the time it existed, but was repeatedly broken up into parts, making possible an exchange of life in different directions.

The particular idea of Hedley on this subject, even if we do not at once accept it, is at least worth considering seriously, and the frequent and very complete references to previous writers form one of the features of his article that make it the more valuable for the student of this fascinating question of the "Antarctica." A. E. O.

ZOÖLOGY.

Accessory Bladders of Turtles. — F. W. Pickel[1] has studied the accessory bladders of turtles, and finds these organs present in semi-

[1] Pickel, F. W. The Accessory Bladders of the Testudinata, *Zoölogical Bulletin*, vol. ii, No. 6, pp. 291–301. September, 1899.

terrestrial and semi-aquatic species. They are wanting, or greatly reduced, in the strictly aquatic and strictly terrestrial forms. The author believes that these bladders are receptacles for liquid stored up for the use of the animal, but he could not confirm the statement of earlier observers that the fluid was water taken in through the cloaca.

G. H. P.

Osteology of the Percesoces. — Professor Edwin Chapin Starks, now of the University of Washington, gives in the *Proceedings of the United States National Museum*, pp. 1–10, a valuable study of the osteology of the suborder of fishes known as Percesoces. He finds the members of this group less closely related than would be supposed from their resemblance in external characters, although really allied. The Sphyrænidæ (Barracudas) stand as a group opposed to the remaining families Mugilidæ (mullets) and Atherinidæ (silversides: Pesce-Rey). The osteology of a typical member of each family is given, with illustrative plates by the skillful hand of Mrs. Starks, who, as Chloe Lesley, was formerly the artist of the Hopkins Laboratory at Stanford University.

In all these species the so-called coronoid bone is present, but Professor Starks doubts its homology with the coronoid bone of reptiles, and thinks that the systematists have made too much of it and the anatomists not enough. It has little systematic value, for it is present in many unrelated genera (catfish, sucker, striped bass, bluefish, cod), while, on the other hand, it has been generally overlooked by anatomists as a structure present in fishes.

Starks on the Relationships of Dinolestes. — In the *Proceedings of the United States National Museum*, Professor Edwin Chapin Starks undertakes to settle the vexed question of the affinities of the Australian fish, *Dinolestes lewini*, by a study of its osteology.

In spite of its resemblance to the Barracuda and the Pesce-Rey, he finds no evidence of close affinity and places Dinolestes among the true percoids. It is probably allied to Sphyrænops and Scombrops and belongs to the family of Cheilodipteridæ.

The Peripheral Nervous System of Bony Fishes. — The cranial and first spinal nerves of the common silverside, Menidia, have been investigated by C. J. Herrick.[1] Four components are now generally recognized in the spinal nerves of vertebrates: (1) somatic motor

[1] Herrick, C. J. The Peripheral Nervous System of the Bony Fishes, *Bull. U. S. Fish Comm., 1898*. pp. 315–320. 1899.

fibres derived from the ventral horn cells of the cord and distributed to the striated body musculature; (2) somatic sensory or general cutaneous fibres terminating in the dorsal horn and supplying the skin of the body; (3) visceral motor fibres supposed to pass from the lateral horn outward by both dorsal and lateral roots; and (4) visceral sensory fibres passing in through the dorsal roots only. In the cranial nerves, in addition to these four components, a fifth, the acustico-lateral, can be distinguished in connection with the ear and lateral line organs. No cranial nerve contains all these components, and there is an obvious tendency towards the concentration of the fibres of each component, so as to form a single system with a common center in the medulla.

The composition of the various cranial nerves is as follows. The hypoglossal is composed of somatic motor fibres and passes out as the first member of the first spinal complex. The spinal accessory is made up of visceral motor fibres and passes out with the vagus to innervate the trapezius muscle. The vagus is in the main formed of visceral motor and visceral sensory fibres, together with a few somatic sensory and acustico-lateral fibres. The glossopharyngeal contains only visceral motor and visceral sensory fibres. The auditory is exclusively acustico-lateral. The facial is composed of visceral motor, visceral sensory, and acustico-lateral fibres. The abducens is wholly somatic motor. The trigeminal is visceral motor and somatic sensory. The trochlear and oculomotor are both somatic motor. The optic and olfactory nerves have not as yet been placed in any category.

G. H. P.

Reactions of Entomostraca to Light. — R. M. Yerkes[1] has studied the reactions of two entomostracans, Simocephalus and Cyclops, to differences in light intensity, photopathy. In the experiments the influence of the direction of the light was eliminated and the animals were subjected to light of graduated intensity. Simocephalus moved into regions of greater intensity of light, *i.e.*, was positively photopathic; and the amount of positive movement varied, within certain limits, directly with the intensity of the light. Diffuse daylight caused a greater positive response than direct sunlight. Cyclops proved to be not photopathic. It was also shown that Simocephalus preferred the orange and yellow portion of the spectrum of illuminating gas, but the author concludes that this is a response to inten-

[1] Yerkes, R. M. Reactions of Entomostraca to Stimulation by Light, *Amer. Journ. Physiol.*, vol. iii, pp. 157–182. November, 1899.

sity (photopathic reaction), and is not, as far as is known, a color response (chromopathy).

G. H. P.

Embryology of the Cladoceran Penilia. — The development of Penilia has been studied by M. T. Sudler.[1] The four to six oval eggs of a single laying are usually so placed in the brood sac of the female that their long axes are very nearly parallel to that of the female. The long axis of the egg corresponds to that of the future embryo, and the end of the embryo pointed forward in the brood sac becomes the head. The segmentation of Penilia is total and remains so throughout in strong contrast to that in most other Crustacea. As in Nereis, the first cleavage plane is transverse to the chief axis of the future embryo; the second is in the sagittal plane; and the third is at right angles to both previous planes; the fourth is parallel to the first; and from the fifth on, no clear characterization can be made. Gastrulation takes place in definite relation to the maternal body, *i.e.*, at what may be described as the outer posterior corner of the embryo. The mesoderm originates from either side of the mid-ventral line, and in a way that prevents it from being clearly distinguished from the entoderm for some time. The gastrula mouth closes in the region afterwards occupied by the anus. The order of appearance of the appendages is open to some variation, but is usually as follows: second antenna, first antenna, mandible, first maxilla, second maxilla, thoracic appendages in sequence from the anterior end. Organogeny is briefly dealt with. The reproductive organs cannot be traced to a single cell, as in Moina according to Grobben. On the whole, Penilia gives evidence of being a highly specialized rather than a primitive cladoceran.

G. H. P.

Artificial Parthenogenesis in the Sea Urchin. — Observations on the influence that various dissolved substances have on living muscle and on the fertilized and unfertilized eggs of marine animals have led Loeb[2] to suspect that the reason unfertilized eggs do not develop is not only because of lack of the spermatozoan, but also because of the constitution of the sea water. The addition of magnesium chloride to sea water (5000 $\frac{1}{8}^{0}$ n $MgCl_2$ in 5000 cc. of sea

[1] Sudler, M. T. The Development of Penilia schmackeri Richard, *Proc. Boston Soc. Nat. Hist.*, vol. 29, pp. 109–131, 3 plates. October, 1899.

[2] Loeb, J. On the Nature of the Process of Fertilization and the Artificial Production of Normal Larvæ (Plutei) from Unfertilized Eggs of the Sea Urchin, *Amer. Journ. Physiol.*, vol. iii, pp. 135–138. October, 1899.

water) produces a solution which affects unfertilized eggs in the same way as the entrance of a spermatozoan does. Eggs of the sea urchin, when left in this solution for about two hours and then transferred to normal sea water, formed gastrulæ and plutei normal in every respect. In the experiment fewer eggs developed, and their development was slower than under normal conditions. This experiment shows that the unfertilized egg of the sea urchin contains all the essential elements for the production of a perfect pluteus. The reason that sea urchin eggs do not develop parthenogenetically under normal conditions is the constitution of the sea water; this either lacks the presence of a sufficient number of ions necessary for cell division (magnesium, potassium, hydroxyl, or others) or it contains too many unfavorable ions (calcium, sodium, or others). All the spermatozoan needs to carry into the egg for fertilization are ions to supplement one class of substances or counteract the other or both. The spermatozoan may of course also carry in other materials, enzymes, etc. The author concludes this interesting paper with the suggestion that possibly parthenogenesis in mammals is prevented by the ions of the mammalian blood. G. H. P.

Notes. — The concluding number of the *Zoölogical Bulletin* contains the following articles: "The Mesenterial Filaments in Zoanthus sociatus," by J. P. McMurrich; "The Unpaired Ectodermal Structures of the Antennata," by M. M. Enteman; "Synopsis of the Calliphorinæ of the United States," by G. de N. Hough; and "The Accessory Bladders of the Testudinata," by F. W. Pickel. It has been announced that the *Bulletin* will be continued under the name of the *Biological Bulletin*.

A Biological Survey of Mount Shasta, California, has been undertaken by the United States Department of Agriculture, and has been reported upon in *North American Fauna*, No. 16. The general features of the mountain, the forests and forest fires, the life zones, the mammals, birds, and plants of the region are described and the factors influencing distribution are discussed.

BOTANY.

Botanical Papers at the British Association. — Some of the papers presented before the botanical section of the British Association were of unusual importance, and the average merit of the

papers was very high. The presidential address, by Sir George King, was an able review of the history of Indian botany, and an added interest was given by the presence of Sir Joseph Hooker, who proposed the vote of thanks for the section.

The masterly address of the president of the chemical section, Dr. Horace J. Brown, on the assimilation of carbon by the higher plants, was quite as much botanical as chemical in nature, and was a real contribution to this important subject.

The following were some of the papers presented: Professor Marshall-Ward, "Methods in the Culture of Algæ"; Sir W. T. Thistleton-Dyer, "The Influence of the Temperature of Liquid Hydrogen on the Germinating Power of Seeds"; Professor Harold Wager, "Lecture on the Sexuality of Fungi"; Professor F. Darwin, "On the Localization of the Irritability of Geotropic Organs"; Professor D. H. Campbell, "Studies on Araceæ"; Mr. J. C. Willis, "The Morphology and Life-history of Ceylonese Podostemonaceæ"; Professor F. O. Bower, "Remarks on Fern-sporangia and Spores"; Professor A. C. Seward, "The Jurassic Flora of Britain"; Professor E. G. Bertrand, "Sur le structure d'une sigillaire cannelée"; Mr. L. A. Boodle, "The Stem-structure in Schizæaceæ, Gleicheniaceæ, and Hymenophyllaceæ."

Perhaps the most sensational paper presented before the botanical section at Dover was the one by Sir William Thistleton-Dyer, on the power of seeds to resist extremely low temperatures. Carefully selected seeds of several kinds were exposed to the temperature of liquid hydrogen; in one set of experiments they were actually placed in liquid hydrogen for six hours! In spite of the extraordinary ordeal to which they had been subjected, the seeds subsequently germinated almost without exception.

A New Book on Ecology. — Modern text-books are conceived in so many spirits and shaped in so many forms that little except the personal bias of the individual teacher would seem necessary to influence a selection. Some are purely didactic categories of fact, some, mechanical guides for laboratory manipulation, and some are readable essays paving the way for pleasant and profitable hours in the laboratory and the field. Professor Coulter has written one of the happiest books of the latter class, in his *Plant Relations*,[1] which is intended to serve as the eye-opener for a half-year's course in

[1] Coulter, J. M. *Plant Relations.* A first book of botany. New York, D. Appleton & Co. x, 264 pp., 206 ff.

elementary botany, and is to be followed by another volume covering the second half-year. It is a logically conceived book, clearly written and well printed, and illustrated with a series of figures each of which is rightly considered by the author to be worthy of as much study as a page of text. Though written with the expressed purpose of accompanying a laboratory course, in which frequent trips to the woods are advised, it is a book which is likely to be read from cover to cover by any bright boy or girl who picks it up and who knows out-of-door life; and it is a book which can do no harm if so read, for its touch with nature is so close, and verification of the chief elements is made so easy, that only a person of the most superficial tendencies could lay it down without turning at once to the plants about which it speaks. The author is to be congratulated on the happy manner in which he has contributed, as he very modestly styles it, another suggestion as to the method of teaching botany in secondary schools.

T.

The Botanists of Philadelphia.[1] — It is always interesting to know what manner of men one's confrères are, and although the barrier of space is now more nearly overcome than it was a generation ago, it is at best only bridged, and many co-workers in the amiable science know each other even yet only through their publications, or at most fragmentary correspondence. Dr. Harshberger's volume on the men who have made Philadelphia famous in the botanical world gives much information that will be welcomed everywhere, and the numerous portraits which enrich it add not a little to its value. The Bartram coat of arms forms an appropriate frontispiece, and the text is enlivened by many views of historic objects, or the beautiful scenery along the Wissahickon. Six appendixes give information concerning organizations, publications, and other matter more or less pertinent to the biographic details which constitute the greater part of the book, and a general index facilitates the finding of desired items.

T.

An Important Bibliographic Aid.[2] — In a massive volume, forming Additional Series III of the Kew *Bulletin of Miscellaneous Information*, the director of the great English garden has given to

[1] Harshberger, J. N. *The Botanists of Philadelphia and their Work.* Philadelphia, 1899. xii, 457 pp.

[2] *Catalogue of the Library of the Royal Botanic Gardens, Kew.* London, 1899. viii, 790 pp. 8vo. Price seven shillings and sixpence.

the public a catalogue of botanical works such as has never before been issued. The titles are printed on one side of each sheet only, so that additions may readily be entered on the blank pages. Four alphabets are made: "General," "Travels," "Periodicals and Serials," and "Manuscripts." T.

The Flora of New Zealand.[1] — The Education Department of the New Zealand Government has issued a handy volume comprising Ranunculaceæ to Compositæ, and forming part of the *Students' Flora* of that region, on which the late Professor Kirk was at work at the time of his death. From an introductory notice it appears that arrangements are likely to be made for completing the work, and it is said that the figures selected to illustrate the *Flora*, and which are to be printed from an unpublished set of copperplates engraved many years ago for Sir Joseph Banks, will form a separate volume. T.

Botanical Notes. — In Vol. XVI of the *Transactions* of the Kansas Academy of Science Professor Hitchcock publishes the first part of a "List of plants in my Florida herbarium." The list is arranged in the familiar sequence of Bentham and Hooker, and extends from Ranunculaceæ through Bromeliaceæ, and includes twelve hundred and fifty-six numbered species and varieties, for each of which localities are cited.

Part XIII of Mr. Macoun's "Contributions to Canadian Botany," published in *The Ottawa Naturalist* for October, contains notes on the distribution of a considerable number of critical species, among which the blue violets are especially notable.

The *Revue Tunisienne* for October contains the concluding part of a catalogue of the vascular plants of the vicinity of Carthage, which should be of interest to travelers in the Mediterranean. It is curious to observe that only one fern, the true maidenhair, is recorded.

An excellent photograph of the trunk of well-grown American white birch is contained in *Forest Leaves* for October.

An analysis of the frond and stipe anatomy of the ferns of the French Flora, and an analytical key to the genera, based on anatomical characters, are contributed by Parmentier to Vol. IX of the *Annales des Sciences Naturelles, Botanique.*

[1] Kirk, T. *The Students' Flora of New Zealand and the Outlying Islands.* Wellington.

Professor D. H. Otis publishes in the last volume of *Transactions* of the Kansas Academy of Science the results of some experiments on the production of root tubercles on Leguminosæ by inoculating the soil in which they were grown with soil containing the symbiotic fungi which cause the tubercles, showing again that it is practicable to produce such tubercles by inoculation.

One hundred and fifty-four Uredineæ of Kansas are enumerated by Mr. Bartholomew in the last volume of *Transactions* of the Kansas Academy of Science.

Mr. J. B. S. Norton has done a useful piece of work in bringing together for the last volume of *Transactions* of the Kansas Academy of Science a bibliography of literature relating to the effects of wind on plants.

The botanical section of the British Association meeting at Dover was well attended by the British botanists, and the sessions were full of interest. The foreign representation was smaller than has usually been the case. Among those who presented papers or took part in the discussion were the following: Professor E. G. Bertrand, Professor F. O. Bower, Professor D. H. Campbell, Professor F. Darwin, Professor J. B. Farmer, Professor Reynolds Green, Professor M. Hartog, Sir Joseph Hooker, Sir George King, Mr. Arthur Lister, Dr. D. H. Scott, Professor A. C. Seward, Sir W. T. Thistleton-Dyer, Professor Harold Wager, Professor H. Marshall-Ward, and others.

NEWS.

THE American Museum of Natural History of New York has had twenty-three representatives in the field during the past summer.

A monument to Johannes Müller was unveiled at Coblenz, his birthplace, on October 2. The principal address was given by Professor Waldeyer.

Sir John William Dawson died November 19. He was born in Pictou, N. S., Oct. 13, 1820. He was educated there and in Edinburgh. In 1842 he accompanied Lyell in his tour through the United States. In 1855 he became principal of McGill College, at Montreal. His work was largely in geological lines, and his most important contributions related to the geology of the maritime provinces. He published a large number of popular works, mostly upon geology and in opposition to the theory of evolution, of which, among scientific men, he was about the last opponent. He was knighted for his work in 1885.

Professor L. V. Pirsson, of Yale, succeeds the late Professor Marsh as one of the associate editors of the *American Journal of Science.*

The New York Zoölogical Gardens were formally opened November 8. They now contain 850 animals.

Appointments: Rollo K. Beatie, instructor in botany in the Agricultural College of Washington. — Dr. August N. Berlese, professor of natural sciences in the Royal Lyceum at Camerino, Italy. — M. Chatin, professor of histology in the faculty of sciences at the Sorbonne, Paris. — Alessandro Coggi, professor of zoölogy in the University of Siena. — Dr. Edward D. Copeland, assistant professor of botany in the University of West Virginia. — Dr. Carl E. Correns, professor extraordinarius of botany in the University of Tübingen. — Edgar R. Cummings, instructor in geology in Indiana University. — Dr. G. V. N. Dearborn, assistant in physiology in the Harvard Medical School. — Professor J. B. De Torri, of Padua, professor of botany in the University of Camerino. — Dr. Sigmund Fuchs, professor of anatomy and physiology in the Vienna Agricultural Station.

— Dr. K. W. Genthe, instructor in zoölogy in the University of Michigan. — A. W. Gibb, lecturer on geology in the University of Aberdeen. — Dr. L. C. Glenn, professor of geology in North Carolina College. — Dr. S. J. Holmes, instructor in zoölogy in the University of Michigan. — Dr. H. S. Jennings, instructor in zoölogy in the University of Michigan. — Dr. J. B. Johnson, assistant professor of biology in the University of West Virginia at Morgantown. — Dr. A. C. Lane, state geologist of Michigan. — Dr. Henry Sabin Leake, professor of anatomy in Williams College. — Dr. M. von Lenhossek, professor of anatomy in the University at Budapest. — J. J. Lister, fellow of St. John's College, Cambridge. — George W. Martin, of Indianapolis, professor of biology in Vanderbilt University, at Nashville, Tenn. — Dr. Merton L. Miller, associate in anthropology in the University of Chicago. — C. B. Morey, assistant professor of anatomy and physiology in the Ohio State University. — Dr. Pegl, docent in physiology in the University at Graz. — A. C. Seward, fellow of St. John's College, Cambridge. — John L. Sheldon, instructor in biology in the Nebraska State Normal School at Peru. — James Y. Simpson, lecturer on natural science in the Free Church College, Glasgow. — Professor Baldwin Spencer, honorary director of the Natural Museum at Melbourne, Australia. — Dr. Otto Stapf, chief assistant in the Kew Herbarium. — W. H. Twelvetrees, geologist to the government of Tasmania. — Dr. Karl Wenle, assistant in the Ethnological Museum in Leipzig. — Dr. William Morton Wheeler, professor of zoölogy in the University of Texas. — Dr. R. S. Woodworth, assistant in physiology in the Medical School of the University of New York.

Deaths : Mr. Grant Allen, a well-known writer on popular science, in London, October 25, aged 51. — Professor J. B. Carnoy, the well-known cytologist of Louvain, September 6, in Schuls, Engadine. — Professor Erhardt, formerly director of the Natural History Museum at Coburg, Germany, aged 80. — Dr. A. Ernst, director of the National Museum at Carácas, Venezuela. — Pasquale Freda, director of the Agricultural Experiment Station at Rome, July 4. — Charles Howie, bryologist, of St. Andrews, Scotland. — Dr. Walter J. Hoffmann, well known for his researches upon American anthropology, at Reading, Pa., November 8, aged 53. — Dr. F. Kuhla, botanical collector, in Mañaos, Brazil. — Dr. Edouard Petri, professor of geography and anthropology in the University of St. Petersburg, aged 45. — Dr. Karl Russ, ornithologist, at Berlin, September 29, aged 66. — Mr.

W. A. Snow, instructor in entomology in Leland Stanford University, drowned in the harbor of San Francisco, October 10. — James Simpson, curator of the Anatomical Museum of the University of Edinburgh. — Dr. Luther Dana Woodbridge, professor of anatomy in Williams College, November 3, aged 49.

CORRESPONDENCE.

To the Editor American Naturalist:

SIR, — *In re* Mesenchyme *vs.* Mesenchyma permit me to differ for the following reasons:

1. Mesenchyme is shorter and hence better.
2. According to the Standard Dictionary it is the preferred form.
3. It is certainly formed on the analogy of a long list of common scientific names in our language, vertebrate from Vertebrata.
4. It is a more natural English form.
5. Do you use the word "chyme"? May I not claim that "it has good usage"? Why then is mesenchyme a "foreign hybrid"?

Very cordially yours,

HENRY B. WARD.

UNIVERSITY OF NEBRASKA, LINCOLN,
Oct. 12, 1899.

PUBLICATIONS RECEIVED.

(The regular exchanges of the *American Naturalist* are not included.)

ACLOQUE, A. Faune de France. Les Oiseaux. Paris. 336 pp., 621 figs.

BARKER, LEWELLYS F. The Nervous System and its Constituent Neurones. Designed for the use of practitioners of medicine and of students of medicine and psychology. With two colored plates and 676 illustrations in the text. New York, D. Appleton & Co., 1899. 32, 1122 pp.

BIOLOGICAL LECTURES from the Marine Biological Laboratory, Woods Holl, Mass., 1898. Boston, Ginn & Company, 1899. 343 pp., figs.

COULTER, JOHN M. Plant Relations. A first book of botany. New York, D. Appleton & Co., 1899. 7, 264 pp., 206 figs.

EVANS, ERNEST. Botany for Beginners. London, Macmillan & Co., 1899. 8, 290 pp., 271 figs.

HERDMAN, W. A. Descriptive Catalogue of the Tunicata in the Australian Museum, Sydney, N.S.W. Liverpool, 1899. 18, 139 pp., 45 plates.

JORDAN, D. S., and others. The Fur Seals and Fur-Seal Islands of the North Pacific Ocean. Part III. Washington, 1899.

KARPINSKY, A. Ueber die Reste von Edestiden und die neue Gattung Helicoprion. St. Petersburg, 1899. 111 pp., 4 plates, 72 figs.

KENNEDY, WARDLAW. Beasts. Thumb-Nail Studies in Pets. London, Macmillan & Co., 1899. 16, 152 pp., figs.

LANIER, SIDNEY. Bob. The Story of our Mocking-Bird. New York, Charles Scribner's Sons, 1899. 64 pp, 16 illustrations. $1.50.

MEUNIER, STANISLAS. La Géologie Expérimentale. Paris, 1899. 8, 311 pp., 56 figs.

WISE, J. S. Diomed. The Life, Travels, and Observations of a Dog. New York, The Macmillan Company, 1899. 6, 330 pp.

ANDERSON, F. M. The Geology of Point Reyes Peninsula. *Bull. Dept. Geol. Univ. Cal.*, 1899. Vol. ii, pp. 119–153, Pl. IV.

BANGS, OUTRAM. On Some New or Rare Birds from the Sierra Nevada De Santa Marta, Colombia. *Proc. Biol. Soc. Washington*, 1899. Vol. xiii, pp. 91–108.

BUMPUS, H. C. The Reappearance of the Tilefish. *Bull. U. S. Fish Commission for 1898.* pp. 321–333.

CHAMBERLIN, T. C. Lord Kelvin's Address on the Age of the Earth as an Abode Fitted for Life. *Science*, 1899, new series. Vols. ix, x.

CLARK, J. F. Electrolytic Dissociation and Toxic Effect. *Journ. Phys. Chem.*, 1899. Vol. iii, pp. 263–316.

CORY, CHARLES B. The Birds of Eastern North America. Water Birds. Part I. Chicago, 1899. pp. 142, figs.

COWLES, H. C. The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan. *Bot. Gaz.*, 1899. Vol. xxvii.

DALL, W. H. Synopsis of the Solenidæ of North America and the Antilles. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 107–112.

ELLIOT, D. G. Catalogue of Mammals from the Olympic Mountains, Washington, with Descriptions of New Species. *Field Columbian Mus., Publication 32*, 1899.

ELLIOT, D. G. Description of apparently New Species and Subspecies of Mammals from the Indian Territory. *Field Columbian Mus., Publication 38*, 1899.

ELLIOT, D. G. Description of apparently New Species and Subspecies of Mammals from Oklahoma Territory. *Field Columbian Mus., Publication 37*, 1899.

ELLIOT, D. G. Preliminary Descriptions of New Rodents from the Olympic Mountains. *Field Columbian Mus., Publication 30*, 1899.

EVERMANN, B. W., AND KENDALL, W. C. Check-List of the Fishes of Florida. *Rept. U. S. Fish Commission for 1899.* pp. 35–103.

FARRINGTON, O. C. A Fossil Egg from South Dakota. *Field Columbian Mus., Publication 35*, 1899.

HARKNESS, H. W. Californian Hypogæous Fungi. *Proc. Cal. Acad. Sci.*, 1899. Third Series, Botany. Vol. i, pp. 241–292, 4 plates.

HARLÉ, ÉDOUARD. Gros Cailloux de la Garonne en Aval du Confluent du Tam. *Bull. Société Géologique de France*, 1899. Sér. 3, Tome xxvii, pp. 348–351.

HARLÉ, ÉDOUARD. Nouvelles Pièces de Dryopitheque et Quelques Coquilles, de Saint-Gaudens (Haute-Garonne). *Bull. Société Géologique de France*, 1899. Sér. 3, Tome xxvii, pp. 304–310, Pl. IV.

HAY, O. P. Descriptions of Two New Species of Tortoises from the Tertiary of the United States. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 21–24, 3 plates.

HAY, W. P. Description of Two New Species of Crayfish. *Proc. U. S. Nat. Mus.*, 1899. Vol xxii, pp. 121–123, figs.

HERRICK, C. JUDSON. The Peripheral Nervous System of the Bony Fishes. *Bull. U. S. Fish Commission for 1898.* pp. 315–320.

HILL, ROBERT T. Notes on the Forest Conditions of Porto Rico. *Bull. 25 U. S. Dept. Agri., Div. Forestry*, 1899. 48 pp., figs.

HOWARD, L. O. Three Insect Enemies of Shade Trees. *U. S. Dept. Agri., Farmer's Bull. No. 99*, 1899. 30 pp., 11 figs.

KELLOGG, V. L. A List of the Biting Lice (Mallophaga) taken from Birds and Mammals of North America. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 39–100.

LO BIANCO, SALVATORE. The Methods Employed at the Naples Zoölogical Station for the Preservation of Marine Animals. Translated from the Italian by E. O. Hovey. *Bull. U. S. Nat. Mus.*, 1899.

LOGAN, W. N. Contributions to the Paleontology of the Upper Cretaceous Series. *Field Columbian Mus., Publication 36*, 1899.

MASON, OTIS TUFTON. The Man's Knife among the North American Indians. *Rept. U. S. Nat. Mus. for 1897, 1899.* pp. 725–745, Figs. 1–17.

MEEKS, S. E. Notes on a Collection of Cold-Blooded Vertebrates from the Olympic Mountains. *Field Columbian Mus., Publication 31*, 1899.

MILLER, G. S., JR. Directions for Preparing Study Specimens of Small Mammals. *Bull. 39, U. S. Nat. Mus.*, 1899. 10 pp., fig.

MILLER, GERRIT S., JR. The Dogbanes of the District of Columbia. *Proc. Biol. Soc. Washington*, 1899. Vol. xiii, pp. 79–90, Pl. II.

MILLER, G. S., JR. A New Tree-Frog from the District of Columbia. *Proc. Biol. Soc. Washington*, 1899. Vol. xiii, pp. 75–78.

MOORE, H. F. An Inquiry into the Feasibility of Introducing Useful Marine Animals into the Waters of Great Salt Lake. *U. S. Fish Commission Rept. for 1899*. pp. 229–250, Pl. VII.

MOORE, J. P. Leurognathus marmorata, a New Genus and Species of Salamander of the Family Desmognathidæ. *Proc. Acad. Nat. Sci. Phil.*, 1899. pp. 316–323, Pl. XIV.

MOORE, J. PERCY. A Snow-Inhabiting Enchytræid (*Mesenchytræus solifugus* Emery) Collected by Mr. Henry G. Bryant on the Malaspina Glacier, Alaska. *Proc. Acad. Nat. Sci. Phil.*, 1899. pp. 125–144, Pl. VII.

NICHOLS, H. W. The Ores of Columbia from Mines in Operation in 1892. *Field Columbian Mus., Publication 33*, 1899.

NUTTALL, GEORGE H. F. On the Rôle of Insects, Arachnids, and Myriapods, as Carriers in the Spread of Bacterial and Parasitic Diseases of Man and Animals. A Critical and Historical Study. *Johns Hopkins Hospital Reports*, 1899. Vol. viii, 154 pp., 3 plates.

OBERHOLSER, HARRY C. A List of the Birds Collected by Mr. R. P. Currie in Liberia. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 25–37, Pl. VII.

OBERHOLSER, H. C. Notes on Birds from the Cameroons District, West Africa. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 11–19.

PALMER, T. S. Notes on Tatona and Other Genera of Edentates. *Proc. Biol. Soc. Washington*, 1899. Vol. xiii, pp. 71–73.

PALMER, WILLIAM. Ferns of the Dismal Swamp, Virginia. *Proc. Biol. Soc. Washington*, 1899. Vol. xiii, pp. 61–70.

PREBLE, EDWARD A. Revision of the Jumping Mice of the Genus Zapus. *North American Fauna, 15*, 1899. 39 pp., 1 plate, 4 figs.

RATHBUN, RICHARD. A Review of the Fisheries in the Contiguous Waters of the State of Washington and British Columbia. *Rept. U.S. Fish Commission for 1899*. pp. 251–350, Pls. VIII–XVI.

RIGGS, E. S. The Mylagaulidæ: An Extinct Family of Sciuromorphi Rodents. *Field Columbian Mus., Publication 34*, 1899.

RUTTER, C. M. Notes on a Collection of Tide-Pool Fishes from Kadiak Island in Alaska. *Bull. U. S. Fish Commission for 1898*. pp. 189–192.

SEDGWICK, ADAM. Variation and Some Phenomena Connected with Reproduction and Sex. Address to Zoölogical Section British Assoc. Adv. Sci. 1899. 19 pp.

SIMPSON, C. T. The Pearly Fresh-Water Mussels of the United States. *Bull. U. S. Fish Commission for 1898*, 1899. pp. 279–288, 8 figs.

SLOSSON, E. E. Alkali Studies, IV. *Ninth Ann. Rept. Wyoming Agri. Exper. Station*, July, 1899.

SMITH, EUGENE. The Turtles and Lizards of the Vicinity of New York City. *Proc. Linnæan Soc. N. Y.*, 1898–99. 1899. No. 11, pp. 11–32.

SMITH, H. M. The Mussel Fishery and Pearl-Button Industry of the Mississippi River. *Bull. U. S. Fish Commission for 1898*. pp. 289–314, Pls. LXV–LXXXV.

SMITH, H. M. Notice of a Tilefish New to the Fauna of the United States. *Bull. U. S. Fish Commission for 1898*. pp. 273–278, Pl. LXIV.

SMITH, H. M. The Southern Spring Mackerel Fishery of the United States. *Bull. U. S. Fish Commission for 1898*. pp. 193–271.

SMITH, H. M., AND BEAN, BARTON A. List of Fishes Known to Inhabit the Waters of the District of Columbia and Vicinity. *Bull. U. S. Fish Commission for* 1898. pp. 179–187.

SMITH, JOHN B. New Species of Nocturnal Moths of the Genus Campometra, and Notes. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 101–105.

SMITH, W. S. T. Some Aspects of Erosion in Relation to the Theory of the Peneplain. *Univ. California Bull. Dept. Geology*, 1899. Vol. ii, pp. 155–178, 2 figs.

SPRINGER, FRANK. Notice of a New Discovery Concerning Uintacrinus. *Amer. Geol.*, 1899. Vol. xxiv.

STARKS, EDWIN C. The Osteological Characters of the Fishes of the Suborder Percesoces. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 1–10, Pls. I–III.

STARKS, EDWIN C. The Osteology and Relationship of the Percoidean Dinolestes lewini. *Proc. U. S. Nat. Mus.*, 1899. Vol. xxii, pp. 113–120, Pls. VIII–XI.

STONE, G. E. Flora of Lake Quinsigamond. N.p., n.d. 12 pp.

STONE, G. E. Past and Present Floral Conditions in Central Massachusetts. *Rhodora*, 1899. Vol. i, pp. 143–148.

TOWNSEND, C. H. Statistics of the Fisheries of the Gulf States. *Rept. U. S. Fish Commission for 1899.* pp. 105–169.

TOWNSEND, C. H. Statistics of the Fisheries of the South Atlantic States. *Rept. U. S. Fish Commission for 1899.* pp. 171–227.

ULINE, E. B. Higinbothamia: New Amaranthaceæ. *Field Columbian Mus., Publication 39*, 1899.

VERRILL, A. E. Report on the Ophiuroidea Collected by the Bahama Expedition in 1893. *Bull. Lab. Nat. Hist. Univ. Iowa*, Sept., 1899. Vol. v, pp. 1–86, Pls. I–VII.

WEEKS, FRED B. Bibliography and Index of North American Geology, Paleontology, Petrology, and Mineralogy for the year 1898. *Bull. 162 U. S. Survey*, 1899. 163 pp.

WILCOX, W. A. Notes on the Foreign Fishery Trade and Local Fisheries. *Rept. U. S. Fish Commission for 1899.* pp. 1–34, Pls. I–VI.

WRIGHT, G. FREDERICK. New Method of Estimating the Age of Niagara Falls. New York, 1899. 10 pp., 5 figs.

Australian Museum. Records. Vol. iii, No. 5. Report of Trustees for the year 1898. pp. 51. — *Berliner Entomologische Zeitschrift.* XLIV, 1899. Heft 1 u. 2. — *Bulletin Médical de Quebec.* September, October, 1899. — *Geographical Journal.* Vol. xiv, Nos. 3–5. — *Gulf Fauna and Flora Bulletin.* Vol. i, No. 1. — *Insect World.* Vol. iii, Nos. 7–9. — *Institut Botanique de Buitenzorg.* Bulletin No. 1. — *Iowa Academy of Sciences.* Proceedings. Vol. vi, pp. 234. — *Johns Hopkins Hospital Bulletin.* Vol. x, Nos. 98–103. Reports. Vol. vii, Nos. 5–9. — *Madras Government Museum.* Report for the year 1898–99. — *Massachusetts Agricultural College, Hatch Experiment Station.* Bulletin No. 62. — *Modern Medicine.* May, July, September. — *Museu Paraense de Historia Natural e Ethnographia.* Boletim. Vol. ii, Nos. 1–4. — *Natural Science Association of Staten Island.* Proceedings. Vol. vii, Nos. 9–11. — *North American Fauna.* No. 16. — *North Carolina College of Agriculture and Mechanic Arts.* Bulletin No. 166. — *Open Court.* Nos. 518–522. — *Revista Chilena de Historia Natural.*

Anno iii, Nos. 5–8. — *Rhode Island College of Agriculture and Mechanic Arts. Agricultural Experiment Station.* Bulletins Nos. 55–59. — *Science Gossip.* Vol. vi, Nos. 64–66. — *Sociedad Cientifica Antonio Alzate, Mexico.* Memorias y Revista. Tome xii, Nums. 11 y 12. — *Société Belge de Microscopie.* Bulletin. Vingt-Cinquième Année. 1898–99. — *Société Royale Malacologique de Belgique.* Annales. Tome xxxii. — *University of Upsala.* Bulletin Geological Institute. Vol. iv, No. 1. — *University of Wyoming, Agricultural College and Agricultural Experiment Station.* Ninth Annual Report.

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